ELECTRICAL WORLD

McGraw-Hill Publishing Company, Inc.

MARCH 12, 1932
25 cents per copy

THE TREND TODAY
IS TOWARD PYREX
POWER INSULATORS

Pyrex is the registered trade mark of Corning Glass Works, Corning, N. Y., and indicates their brand of resistant glass.

MEETING THE NEEDS OF TODAY —AND THE FUTURE

MURRAY No. 278

IN ONE UNIT
MAIN FUSE SWITCH
ELECTRIC RANGE CIRCUIT
WATER HEATER CIRCUIT
FOUR DISTRIBUTION CIRCUITS
METER MOUNTING BOARD

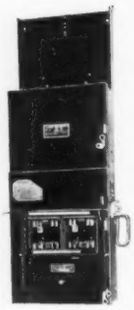
FOR USE WITH NEW METER SEQUENCE
(Meter Connection Test Block before Meter)

Even though an installation does not call for all the services provided, the installation of No. 278 obviates replacements when demands increase.

METROPOLITAN DEVICE CORPORATION
BROOKLYN, N. Y.

"ON" position showing distribution and water heater fuse compartment open.

"ON" position—main and range fuses not accessible until handle is in "OPEN DOOR" and service disconnected.



"OPEN DOOR" position — main fuses and range fuses accessible. Service disconnected.

No. 279—Similar to 278, has no compartment for test block or meter board for meter mounting. May be used where test block is in separate cabinet.

There is considerable saving in material and labor in the installation of this all-purpose switch, when compared to the cost of installing separate units, to obtain the same results.

Metropolitan Device Corporation
1250 Atlantic Ave.
Brooklyn, N. Y.

Please send 12-page booklet of Range Switches.

Name..... Company.....

Position..... Address.....

ELECTRICAL WORLD

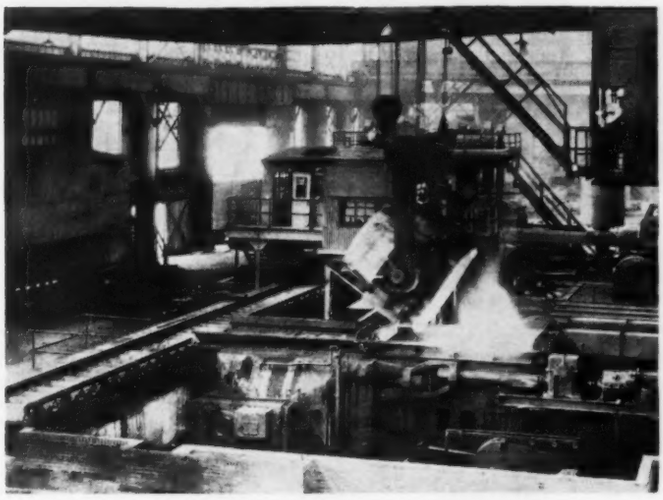
A consolidation of Electrical World, Electrical Engineer and American Electrician

ALLEN M. PERRY
Managing Editor
EARL WHITEHORNE
Contributing Editor
G. F. WITTIG
Statistical Editor
H. M. CAMERON
Associate Editor
A. E. KNOWLTON
Associate Editor
[illegible] C. WELLS
[illegible] Editor
[illegible] H. SEARLES
[illegible]ssistant Editor

L. W. W. MORROW, *Editor*

FRANK R. INNES
Western Editor
520 N. Michigan Ave.
Chicago
H. S. KNOWLTON
New England Editor
1427 Statler Bldg.
Boston
WALTER C. HESTON
Pacific Coast Editor
883 Mission St.
San Francisco
PAUL WOOTON
Washington
Correspondent
National Press Building
Washington

JAMES H. RUDD
Publishing Director



900-ton Electric ingot press A. M. Byers Co., Ambridge, Pa.

MARCH 12, 1932

Contents, Copyrighted, 1932, by McGraw-Hill Publishing Company, Inc.

VOLUME 99 . . . NUMBER 11

News of the Industry..... 469

Wisconsin's Latest Steps in Utility Regulation 486
By DAVID E. LILIENTHAL, *Public Service Commission of Wisconsin*

Utility Ties Valuable to Steel Plants..... 491
By A. H. DYCKERHOFF

Frequency, Time and Load Control on Interconnected Systems..... 495
By PHILIP SPORN and V. M. MARQUIS, *American Gas & Electric Company*

Heat Pump Shows 2.8 Coefficient of Performance..... 502

Editorials 482

Cable Service Uninterrupted Though Channel is Dredged..489

Substation Structure Lowered by Shortening Supporting Towers.490

Lighting a Small Art Gallery..494

Electric Plating Furnace Speeds Operations 500

Characteristics of Flour Mill Loads 501

Vacuum Casting Improved to Eliminate Voids 505

Simplicity in Distribution Substation Design 506

Dialing Controls Signals on Power Supervisor's Board.....507

Readers' Forum 508

Men of the Industry 509

Trade News 511

New Equipment Available.....512

Electrical World articles are indexed in Industrial Arts and Engineering Indexes, available in public libraries

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

CHICAGO, 520 N. Michigan Ave. 883 Mission St., SAN FRANCISCO Aldwych House, Aldwych, LONDON, W.C. 2

JAMES H. McGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. McGRAW, JR., Vice-Pres and Treas.
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
H. C. PARMELEE, Vice-Pres. and Editorial Director
HAROLD W. McGRAW, Vice-President
C. H. THOMPSON, Secretary

Published weekly. $5 per year. 25 cents per copy. Foreign, $9 U. S. currency, or 45 shillings, per year. Canada subscription price (including Canadian duty), $7.50. Entered as second-class matter, January 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

CABLE ADDRESS: "MCGRAWHILL, N.Y."

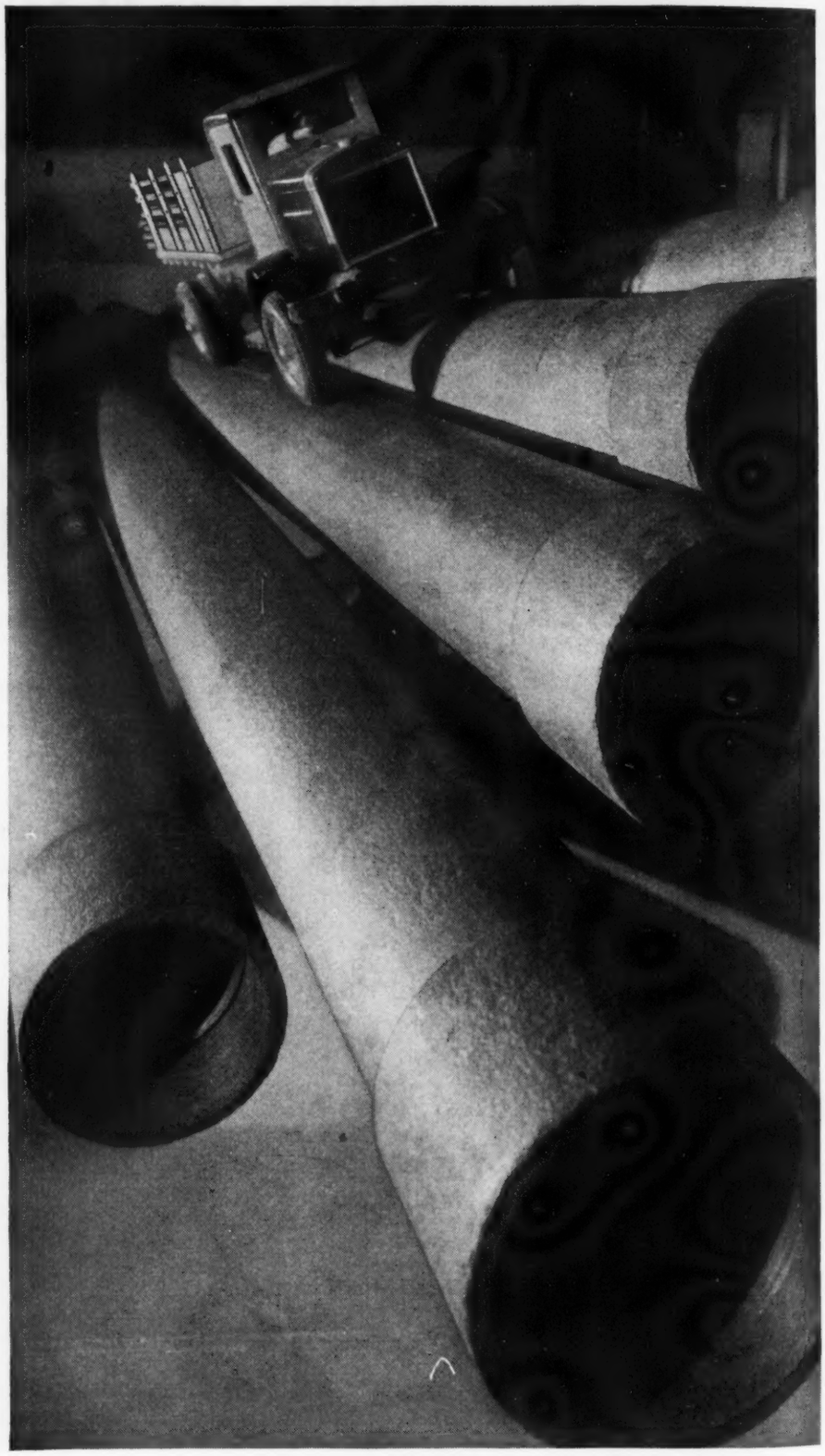
Member A.B.P. *Member A.B.C.*

NUMBER OF COPIES PRINTED THIS ISSUE, 16,610

WASHINGTON, National Press Building
PHILADELPHIA, 1600 Arch Street
CLEVELAND, 501 Guardian Building
DETROIT, 2-257 General Motors Building
ST. LOUIS, 1556 Bell Telephone Building
BOSTON, 1427 Statler Building
GREENVILLE, S. C., 1301 Woodside Building
LOS ANGELES, 339 Chamber of Commerce Building

ORANGEBURG FIBRE CONDUIT — *time-tested in 39 years' service*

A mile of conduit to a 5-ton truck



SO light . . . yet so strong, so tough . . . Orangeburg Fibre Conduit can be rapidly handled and transported in large loads with the minimum danger of breakage.

There's one big saving. Here's another. Orangeburg Fibre Conduit lays up fast . . . forms perfect joints . . . can be rapidly, accurately aligned. For it is made up in 5- and 8-foot lengths, consistently uniform in bore, wall thickness and machining of joints.

39 years of successful service on tens of thousands of miles of electric ductways have made Orangeburg Fibre Conduit the standard underground protection for leading utility companies, municipalities and other conduit users throughout the world.

In all climates, under all soil conditions, it provides high resistance to corrosion, reduces the possibility of electrolytic or stray current damage.

• • •

Use Orangeburg Conduit on your next job. Your order will be promptly filled . . . wherever you are. One factory in Orangeburg, N. Y. — another in Richmond, Indiana, manufacture Orangeburg Conduit exclusively. Stocks in all larger cities keep transportation charges low, avoid costly delays.

The Fibre Conduit Company • ORANGEBURG, N. Y.

SOLE SELLING AGENT Johns-Manville 292 MADISON AVENUE NEW YORK CITY

ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

March 12, 1932

A 2¼ per cent sales tax on all industry

—**Increased taxes are certain** as the House of Representatives considers provisions of new bill reported to it by ways and means committee. Income and sales taxes for all of America's industries probable. Electrical men face many problems—*p. 470.*

—**Wisconsin's regulatory policy** has been thoroughly revamped in an effort to meet the needs of the times. Commissioner Lilienthal gives an unofficial interpretation of the fundamentals involved as he sees them—*p. 486.*

New York has pumped-hydro project

—**Gas and pumped-hydro plans** combined on New York State property where natural gas in internal-combustion engines furnishes power to create hydro resources. A pioneering 12,600-hp. project by the Lamoka Power Corporation—*p. 473.*

—**In interconnected operations** many problems arise which can be solved only with their related character in mind. Automatic frequency control at many points rather than at a single one suggested—*p. 495.*

Long Beach range sales off 76 per cent

—**Sales of merchandise slump** when the utility steps out of the picture. Long Beach, Calif., finds that range unit placements are off 76 per cent in 1930-1931 comparisons of before-and-after statistics. Similar results encountered elsewhere—*p. 472.*

—**An investment trust inquiry** recommended by Attorney-General Bennett of New York in a report to the Legislature. Many policies of these organizations assailed as dangerous to investors—*p. 482.*

"Shot welding" enters the fabricating field

—**Stainless steel can be welded** without impairing its corrosion resistance. Development of "shot-welding" process brings time control of 1,200-amp. currents within a practical 0.01 to 0.001 second range. A new era in fabricating practices?—*p. 480.*

—**Drumm storage battery facts** slowly come to light. Performance of alkaline accumulator with an electrolyte of dissolved zinc oxide and nickel cathodes which receive metallic zinc on charge is phenomenal—*p. 477.*

Federal Revenue Bill Puts Sales Tax of 2¼ per Cent on Electricity

WHEN the ways and means committee of the House of Representatives on Monday of this week reported its tax bill, designed to balance the budget and bolster the credit of the United States, it was found to contain neither the 7 per cent tax on domestic electricity recommended by the Secretary of the Treasury nor the 5 per cent tax on all manufactured electricity at one time advocated by Acting Chairman Crisp. It does, however, contain a 2¼ per cent manufacturers' excise tax to be imposed, with certain exceptions, "on the sale of every article sold in the United States by the manufacturer or producer thereof, if licensed or required to be licensed under this title" (as all manufacturers with an annual production of $20,000 are), and in defining the term "article" as used in this clause the bill specifically includes electricity and gas. Excluded from the tax are what may be succinctly called sales of "raw material" for further manufacture, sales for exportation, sales to a state or political subdivision of "articles for use solely in the exercise of a governmental function," and sales of farm produce and other listed exempt articles, as well as things already subject to internal revenue taxation.

The bill is a long and intricate one and will, of course, provoke extended and acrimonious debate in Congress and possibly be radically amended. As it stands, it seems to mean that the government will collect from the original producer of electrical energy the 2¼ per cent tax. Whether this tax, which obviously affects contracts and franchises, can be recovered from the ultimate consumer only by increased rates duly approved by the state public service commissions or by municipal authorities where commissions do not exist—or, failing their consent, by action of the courts—or whether the tax can be added to the customers' bills without any formal process of the kinds mentioned, has not at the time of writing been made clear, and it is possible that a legal issue will arise in this connection. Municipal generating plants are apparently not exempted in the bill from paying the tax in their proprietary capacity where they generate and sell to customers.

Another section of the law raises from 12 to 13 per cent the tax on the net income in excess of credits of every corporation.

▼

Electrical Men Lead in Patent Office Honors

Thirteen living notable inventors, or scientists who possess inventive talents, will receive urgent invitations to attend the opening of the new Patent Office at Washington on April 11, when they will be entertained by a committee of national scope. The thirteen distinguished scientists include four men in the organization of the General Electric Company—Prof. Elihu Thomson, Dr. Willis R. Whitney, Dr. William D. Coolidge and Dr. Irving Langmuir.

Among the nine remaining invitees are Prof. Michael I. Pupin of Columbia University, who made possible long-distance telephony; Nikola Tesla, inventor of the modern alternating-current induction motor; Senator Guglielmo Marconi of wireless fame; Dr. Frank B. Jewett, director of the research laboratories of the Bell Telephone Company; General J. J. Carty of the Bell Telephone Company and Dr. Leo H. Baekeland, inventor of bakelite, all of whom must be classed as belonging to electrical science or art. Orville Wright, co-inventor of the airplane; Charles F. Kettering, vice-president of General Motors Corporation and director of its research laboratory, and Dr. Charles L. Reese of the Dupont organization make up the thirteen.

▼

N.E.L.A. Conferences to Further Home Service

Two "home service conferences" have been planned as an aid to the merchandising programs of the Commercial Section of the N.E.L.A. The New England Division will hold a two-day conference at Boston on March 29 and 30, and another conference will be held in New York City April 4 to 6.

The tentative program of the Boston meeting, to be held at the Hotel Statler, will cover lecture demonstrations from the standpoint of public relations and the increased sale of appliances, instruction to the new appliance user in the home, what the homemaker wants to know about electrical household equipment, home service "on the air," home lighting, millions for home service via the range, co-operating with rural home demonstrators, how the home service director of a utility can co-operate with the home economics teachers, and co-operation with local dealers.

The New York meetings, to be held in the Electrical Institute of the Electrical Association, are to concern themselves with what home service can contribute to merchandising of household electrical appliances, the measurement of home service results, manufacturers' co-operation, advertising and merchandising, the electric range campaign, developments in electric refrigeration campaign plans, efficient heating of water electrically, merchandising sales committee plans, the domestic lighting campaign, electrically produced sunlight, domestic air conditioning, dealer relations and special activities.

▼

OVERHEAD LIGHTING DISCARDED FOR THIS AUSTRALIAN BRIDGE

With all the lighting units installed on the roadway, the Sydney Harbor bridge, to be opened this month, will differ in that respect from its fellow across the Hudson River between New York and New Jersey. Otherwise it might paradoxically be called an antipodean replica of the American structure on a somewhat smaller scale.

—Keystone View Co.

Governor Roosevelt Returns to the Charge

Once more Governor Roosevelt of New York has asked the Legislature of his state to pass measures to aid the Public Service Commission in extending its control over public utilities. In a special message sent to the Legislature on March 2, the Governor said that although large amounts were spent in 1929 and 1930 to bring about the revision of the commission's laws, the expenditures have not as yet produced any direct benefit for the people. The message continued:

Even the recommendations of the majority members of the [investigating] commission, which were wholly inadequate, were so completely emasculated through the lobbying activities of the utility companies of the state in the legislation which was passed that I was compelled to veto the bills so as to prevent an actual fraud being perpetrated on the public by giving to the public the impression that something substantial had been done for them.

It is with regret that I note that so far your honorable bodies have done nothing to provide the real protection to the rate-paying public to which it is entitled. It is a startling fact that in spite of the current change in the purchasing power of the dollar, there seems to be no voluntary state-wide or nation-wide effort by utility companies to cut their rates proportionately to the cuts being made in other commodities. The best way in which to bring about reductions in rates is to give the Public Service Commission more adequate powers.

I have asked the Legislature for several years to act. Bills to accomplish something effective have been introduced by the minority leaders in the Legislature after waiting in vain this session for your honorable bodies to take action. If your honorable bodies are sincere in a desire to save money for the taxpayers of the state without at the same time throwing thousands of people out of work, this is a way to accomplish a saving that will be felt in practically every home in the state.

Bills carrying the recommendations of the minority members of the commission, which at the past two sessions have been rejected by the Republican leaders, were reintroduced on the same day by Assemblyman Irwin Steingut, Democratic leader. These bills were summarized in the ELECTRICAL WORLD last week (page 427).

▼

Twenty-Million-Dollar Cut in New York Rates Asked

Linking rate negotiation with "defeatism," the City Affairs Committee of New York has demanded from the Public Service Commission of the state a "scientific and thorough investigation of the rates for all consumers of the four-system companies."

It insists that the lower operating costs now prevailing and other factors make possible the reduction of light and power bills by $20,000,000 a year.

The committee's brief asks for immediate revocation of the existing rate schedules and their replacement by an intermediate set of rates to bring about the reductions asked.

The brief asserts also that the Consolidated Gas Company, acting as middleman, is charging the public $4,800,000 a year for wholly unnecessary services in raising capital for the New York Edison Company, which could readily raise its own funds.

▼

Power Commission Argues Against Lockport's Claim

Asserting that the courts cannot interfere with government agencies and bureaus in the discretionary exercise of their duties, the Federal Power Commission on Monday asked the District of Columbia Supreme Court to dismiss the petition of the city of Lockport, N. Y., for a mandamus to compel the commission to issue a permit to the municipality for the diversion of 275 sec.-ft. of water from the Niagara River.

Assistant United States Attorney John W. Fihelly, who filed the answer for the commission, declared that a temporary permit already had been given to the Niagara Falls Power Company after due notice to all parties concerned and that the municipality did not oppose issuance of the permit. Lockport's claim that as a municipality it should have by the terms of the water-power law precedence over a power company was contested by the commission, which maintained that diversion of water at Niagara Falls was governed by the treaty with Canada.

▼

Kentucky Commission Bill Passes Senate, 24 to 1

A bill which is designed to set up a Public Service Commission for Kentucky was passed in the State Senate on March 1 and sent to the House. The bill provides for the appointment by the Governor of a commission of three members to regulate gas companies, electricity companies, pipe-line companies, water companies, telephone and telegraph companies, bus and truck companies, steamboat lines and street, suburban and interurban railways.

Members of the commission would receive $5,000 a year and would serve for four years. The commission would be empowered to hold hearings to fix rates and establish regulations for the utilities under its control. Its expenses would be paid by assessments against the utilities it regulates equal to one-twenty-fifth of 1 per cent of the total assessments. All power now held by the State Railroad Commission to regulate utilities other than state railroads would be taken over by the new Public Service Commission.

The bill passed the Senate by a vote of 24 to 1. An attempt to amend it to exclude from its provisions public utilities in first-class cities was defeated.

▼

Ontario Government Upheld in Contention Over Hydro

A wide-open investigation into the affairs of the Ontario Hydro-Electric Power Commission has been definitely refused by the Ontario government. At a recent sitting of the Legislature the commission received what amounted to a vote of confidence when 76 members voted against an amendment moved by the Liberal leader, W. E. N. Sinclair, which called for a sweeping inquiry into Hydro affairs.

On the previous day Dr. George A. McQuibban, Liberal whip, had declared that Ontario was purchasing hydro power from the Province of Quebec when Ontario power plants were running at only one-half normal capacity. Dr. McQuibban had quoted copious statistics in support of his claim. Premier Henry declared that Dr. McQuibban had based his whole argument on false figures, purporting to show a surplus of capacity at Niagara over peak load of 52,000 hp., whereas the correct figures

Bank Situation Clearing; Automobile Sales Drop

DISAPPOINTING sales figures for the automotive industry continue and negate the hope that America's favorite luxury will do much to pull the nation out of the economic mire this season.

Anti-hoarding ballyhoo having been used to make the public "reflation"-conscious is now directed at the banks themselves as official fingers are ominously pointed at certain unnamed but alleged malefactors against the public interest.

New taxes are debated and revenues gayly predicted, but what will the income figures for the 1931 levy show? That is the question of the moment.

England shows America a lesson in courage and recovery as gold at the rate of £1,000,000 a week is sold for paper pounds and emergency loans are repaid banks here.

Continued decrease in bank failures offers the most hopeful sign of the times just now. Railroad earnings off 60 per cent. Freight-car loadings almost touch previous low. Nothing particularly bright or cheering to be discerned in commodity indexes or industrial barometers as another week drifts by.

from the commission's report show that except for the Gatineau contract there would have been a shortage of capacity amounting to 213,073 hp. below the peak load on plants.

In reply to questions Premier Henry declared that one contract made by the Hydro-Electric Power Commission for Gatineau power was payable in United States funds, while the second was not. The first contract, made in May, 1926, called for 260,000 hp. at $15 per horsepower for 30 years. The second contract provided for a minimum of 6,000 hp. for 1928-29 and a minimum increase of 6,000 hp. per year for ten years. Prices were $14.55 for the first 80,000 hp., $14.50 from 80,000 hp. to 100,000 hp. and $14.45 for 100,000 hp. or more.

Because of the illness of Judge W. E. Middleton, who is conducting the royal commission inquiry into the payment by the Ontario Hydro-Electric Power Commission of $50,000 to John Aird, Jr., in connection with the purchase of power rights on the Madawaska River from the M. J. O'Brien interests, and the commission's payment of $22,000,000 for the Dominion Power & Transmission Company's properties, progress has been slow. Both Mr. Aird and his former partner, R. W. Millard, testified that all their papers relating to the Madawaska negotiations had disappeared. Mr. Aird said he had worked on the deal two or three years and had furnished the Hydro Commission with many data and engineering details about the property.

When counsel for the Liberal and Progressive leaders of Ontario endeavored to question F. A. Gaby, chief engineer of the Hydro Commission, concerning the propriety of the payment of $1,800,000 to the O'Brien interests for the Madawaska properties, the commissioner insisted that no evidence could be taken in that regard.

▼

Owens at Tulsa Stresses Proper State Regulation

Registration was about 700 at the two-day annual convention of the Oklahoma Utilities Association at Tulsa, Tuesday and Wednesday, March 8 and 9. J. F. Owens, president of the National Electric Light Association and vice-president Oklahoma Gas & Electric Company, delivered the principal address at the dinner on Tuesday night, defending proper state commission regulation of the public utility industry and declaring that the industry should remain stabilized during times of depression to protect service and the investment of thousands of customer-owners and because the industry during good times, if properly regulated, passes its surplus earnings back to its customers in reduced rates, instead of building huge reserves, as do some other industries.

Officers elected were: President, R. J. Daugherty, Bartlesville; first vice-president, R. J. Bensel, Oklahoma City; second vice-president, H. B. Cobban, Miami; treasurer, W. R. Emerson, Oklahoma City (re-elected); manager, E. F. McKay, Oklahoma City (re-elected). S. I. McElhoes, retiring president of the association and vice-president Southwestern Light & Power Company, Oklahoma City, will be chairman of the Electric Light and Power Division.

Department Stores and Electrical Merchandising

Kenneth Dameron, recently appointed to be director of the joint committee on electrical merchandising established a year ago by the National Retail Dry Goods Association, the National Retail Hardware Association and the National Electric Light Association (ELECTRICAL WORLD, February 21, 1931, page 347), has reported on a survey made by him with particular reference to sales of electrical appliances in department stores. It is his intention to analyze the present channels of distribution as well as the marketing problems incident to the sale of appliances. In this first report he says in part:

Why department stores in past years failed to interpret rising standards of living in terms of a new and forceful demand for electrical goods remains a mystery. An analysis of the department-store methods of merchandising indicates that the sale of electrical appliances has been approached piecemeal. The sale of two or three appliances at a special price is a wholly inadequate method of meeting the larger problem.

Each home and each room has a well-defined set of requirements calling for electrical appliances. Would it not be desirable for stores to point out to customers the desirability of purchasing electrical appliances on a larger basis? It is believed that the time is not far distant when the consumer financing of electrical appliances will follow not a single appliance, but the requirements of the consumer for a whole set of appliances.

Actually, the planning of household

▼

FLOODING IN BLACK CANYON OBSTRUCTS HOOVER DAM BEGINNINGS

—International News Photos

Hoover Dam site was recently overflowed because of floods in the Colorado River, and for a while the diversion-tunnel openings were under 11 ft. of water.

electrical equipment for a given family, living in a specific house and with definite limitations of means and habits of living, is as important an aspect of merchandising as is the sale itself. In but few instances has the department store attempted to go to the consumer and deal with her problem of household equipment in a manner which conceives the problem as a whole and not by the piece.

▼

Range Sales Slump with Dealer Merchandising

After considerably more than a year's effort on the part of retail dealers of Long Beach, Calif., to do the utility's load-building job, figures complied by the Pacific Coast Electrical Bureau, an industry co-operative organization, show that electric range sales have fallen off 76 per cent.

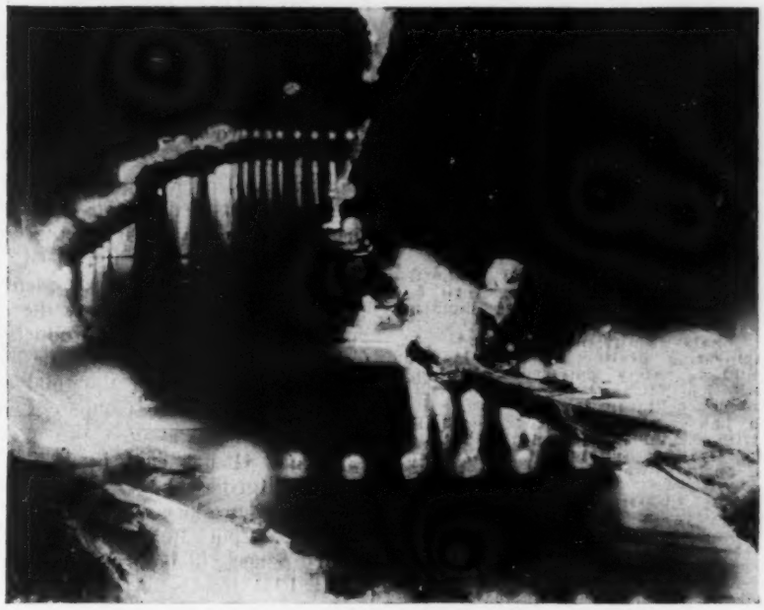
Largely at the behest of the dealers, the Southern California Edison Company withdrew from all appliance selling in October, 1930. For the first eleven months of 1930 the power company had sold 220 ranges, sales to apartment houses had been 141 and dealers had sold 11, or a total of 372 ranges. For the same eleven months of 1931, with the power company inactive, sales to apartment houses were 27 and dealers sold 59, or a total of 86. This represents a falling off in volume of 286 ranges, or 76 per cent.

Another experiment in the San Joaquin Valley division of the Southern California Edison began when the power company ceased merchandising at the beginning of 1931. There has been much controversy over the outcome of this experiment, but, gaged by range sales alone, the only appliance for which exact figures are obtainable, results tally closely with those at Long Beach. Total range sales by power company and dealers combined for 1930 were 722. Sales for the first eleven months of 1931 under dealer activity alone were 158. Estimating fifteen for the month of December, the total for the year would be 173. This is a reduction in range sales of 549, or 76 per cent, identical with results at Long Beach.

The bureau's report concludes with this statement:

"It will be noted in the cases of both Long Beach and the San Joaquin Valley that the range sales showed a reduction in each instance of 76 per cent. Granting every possible latitude in the matter of variability of conditions for the two years and with allowance for every probable pretext upon which this falling off in volume can theoretically be accounted for, these facts conclusively prove that in these two test cases the dealers have not fulfilled their assurances in carrying on the load-building programs of the power companies."

BY NIGHT AND DAY WORK GOES ON AT HOOVER DAM



Powerful floodlights make it possible to carry on construction work 24 hours a day. On the right, in obscurity, are the downstream portals of the two 50-ft. diversion tunnels on the Arizona side.

▼

New Defendants Added in Government Radio Suit

An amended and supplemental petition was filed on March 7 by the United States Attorney-General with the District Court at Wilmington, Del., in the case brought by the United States against the Radio Corporation of America and its associates. The new pleading amplifies the petition originally filed and alleges additional facts relating to certain activities of the defendants in foreign trade and international communications, charging them with attempts to restrain commerce between the United States and foreign countries as well as domestic commerce. Three new defendants are added because of these allegations—the International General Electric Company, Westinghouse Electric International Company and R.C.A. Communications, Inc. The National Broadcasting Company is also added as a party defendant. The petition alleges that this corporation is jointly owned by Radio Corporation, the General Electric Company and the Westinghouse Electric & Manufacturing Company and that it was organized for the purpose of restraining competition in the business of nation-wide broadcasting.

Negotiations have been conducted for some time between the defendants and the government and between the defendants themselves with respect to the possibility of creating an open patent pool which would obviate the trial of some of the important issues of the case. The filing of the amended bill does not mean that these negotiations have been broken off, but the government has been going on with its preparations for trial pending the outcome of these negotiations, with the purpose of having the case heard this spring. The filing of the amended bill is in line with these preparations.

▼

Litigation May Delay Port Washington Plant

A two-year extension of time has been asked from the Common Council of Port Washington, Wis., by the Milwaukee Electric Railway & Light Company, in which to complete the first unit of its twenty-five-million-dollar power plant in that city. It was originally agreed in the contract with the city that this unit should be completed and in operation by 1933. The reason for asking the time extension is a faulty title involving a piece of property on which the plant itself will stand.

William A. Jackson, vice-president of the company, said: "The company is asking the extension merely to protect its interests in the event that litigation delays construction activities. It is the company's intention to complete the plant some time in 1933, but we do not know whether impending litigation will delay activities." He said that the company has spent nearly two million dollars for improvements at Port Washington up to date and fears to spend more while the land title is not clear. Court action is termed necessary to clear the title.

Coming Meetings

American Institute of Electrical Engineers—District meeting, New Pfister Hotel, Milwaukee, March 14-16; Providence, May 4-7. Acting secretary, 33 West 39th St., New York.

Pacific Coast Electrical Association—Commercial Section, Santa Cruz, Calif., March 17 and 18. K. I. Dazey, 447 Sutter St., San Francisco.

National Electric Light Association — Group committee meetings, Commercial National Section, Edgewater Beach Hotel, Chicago, March 22-24. A. J. Marshall, 420 Lexington Ave., New York.

Maryland Utilities Association — Lord Baltimore Hotel, Baltimore, April 8, D. E. Kinnear, 803 Court Square Bldg., Baltimore.

New England Division, N.E.L.A. — Engineering Section, Boston, March 3 and 4; safety conference, Boston, April 8. Miss O. A. Bursiel, 20 Providence St., Boston.

Great Lakes Division, N.E.L.A.—Engineering Section, Sherman Hotel, Chicago, April 13 and 14. R. G. Walter, Wisconsin Power & Light Co., Madison, Wis.

Northwest Electric Light and Power Association — Engineering Section, Heathman Hotel, Portland, April 13-15; H. H. Schoolfield, Pacific Power & Light Company, Portland. Accounting Section, Davenport Hotel, Spokane, Wash., April 18-19; W. F. Miller, Washington Water Power Company, Spokane.

Electrochemical Society — Lord Baltimore Hotel, Baltimore, April 21-23. C. G. Fink, Columbia University, New York.

Southwestern Division, N.E.L.A. — Arlington Hotel, Hot Springs, Ark., April 25-28. S. J. Ballinger, San Antonio Public Service Co., San Antonio.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 28-30. Jesse Blythe, 103 West High St., Jefferson City, Mo.

National Fire Protection Association—Atlantic City, N. J., May 9-12. A. R. Small, 109 Leonard St., New York.

Middle West Division, N.E.L.A. — Muehlbach Hotel, Kansas City, Mo., May 18-20. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

East Central Division, N.E.L.A.—Commodore Perry Hotel, Toledo, Ohio, May 24-27. D. L. Gaskill, 603 Broadway, Greenville, Ohio.

National Electric Light Association — Atlantic City, N. J., June 6-10. A. J. Marshall, 420 Lexington Ave., New York.

▼

California Pendulum Again Swings Over to Hydro End

Utilization of many California water-pumping plants which have been idle for several seasons because of lowered water levels will be an important factor this year in equalizing the agricultural power load of the state's electric utility companies, according to R. H. Ballard, president of the Southern California Edison Company. The protracted dry cycle which apparently has been broken by the present very wet season forced the abandonment of many pumping plants in certain agricultural areas, he says. With the replenishing of the underground water supplies by this season's rainfall, many of these plants again will be placed in operation, thus compensating for the normal reduction in electric pumping load that comes with a normal season of rainfall. An ideal situation as to water supply, from the viewpoints of both ranchers and the electric utilities, prevails throughout the state, Mr. Ballard announces.

The plentiful rainfall and deep snow pack of the present season likewise assure the light and power companies of adequate water supply for the operation of their hydro-electric plants, he adds. Companies such as the Edison which maintain a generating system evenly balanced in hydro-electric and steam-electric generating capacity entered 1932 with the prospect of increased hydro operation and reduced steam-plant generation. The year 1931 saw the lowest point for hydro-electric production in California since 1924. On the Edison system 53 per cent of the total output was produced in the company's steam-electric plants, as against 38 per cent in 1930 and 41 per cent in 1929. This year California power companies will be able to produce twice their hydro-electric output in 1931, and steam-electric energy may be only one-eighth of its 1931 total.

▼

Quadruple Regulation of Utilities Urged by Cooke

Morris L. Cooke of Philadelphia, member of the New York Power Authority, declares in the March number of the *Survey Graphic* that, since domestic and small commercial customers of light and power companies consume only 30 per cent of the energy sold and contribute about 61 per cent of the revenue, the rates which they pay "are perhaps twice as high as they should be." In seeking to remedy this condition, Mr. Cooke emphasizes "power planning for the future" and enumerates two federal and two state boards as the proper instrumentalities to discharge this task. These agencies are:

1. A federal body analogous to the Interstate Commerce Commission to regulate transmission of power across state boundaries and to regulate power holding companies operating in more than one state.

2. A federal electric planning board with administrative authority to study the electrical needs of the country today and as they will be a generation from now; to establish a nation-wide plan for affording the cheapest power for the farm, the home and the factory; to conserve power resources, and to plan out a unified, co-ordinated and economical system of national electrification.

3. State commissions with administrative, as contrasted with judicial, powers emphasized or, if necessary, augmented. Such commissions should simplify and standardize rate schedules, institute revealing accounting, and revamp rates so that the several classes of service will be more nearly self-sustaining.

4. A "giant power board" in every state to study out and safeguard its own electrical future and to co-operate with the equivalent federal authority.

Gas and Hydro Operation Unified in New York

Said to be one of the most unusual power developments in the world, the gas-power, hydraulic-storage project for the generation of electrical energy by the Lamoka Power Corporation at Sodus, N. Y., mentioned in previous issues of the ELECTRICAL WORLD, is now in partial operation.

Some of the largest natural-gas wells in New York State with a gaged open flow of nearly 100,000,000 cu.ft. a day are on the property owned by the Lamoka Power Corporation and controlled by the Bigelow Gas Corporation, which is 99 per cent Lamoka-owned. The output of these wells is utilized on a constant-load basis to operate gas-engine-driven generators which produce a pumped-storage hydro-electric power supply on the same property.

At present a 3,000-hp. plant is in operation and has produced 1,100,000 kw.-hr. during the past 30 days. A 1,200-hp. gas engine-generator unit is to be added by April 1. Orders have been placed for 5,400 hp. additional gas-engine capacity plus 7,500 hp. of hydro-electric wheels and generators.

A generating capacity of 12,600 hp. will probably be in operation by January 1, 1933, according to G. R. Mills, president of the Lamoka Power Corporation. Mr. Mills further says: "We can find no other instance where a company, without going off its own land, can produce millions of kilowatt-hours a month from water stored on the top of its property and also from gas stored under the same land. This is akin to the plan of the farmer who stood his land on end and cultivated both sides."

▼

Attack on Light Bureau Fails to Move Seattle

Frank Edwards, former Mayor of Seattle, who was recalled by the voters last summer following his dismissal of James D. Ross as city superintendent of light, and who had made a vigorous attempt to get back, was defeated again on Tuesday of this week at the regular city election by a record majority of 31,000, his repeated accusations against the light department thus failing to attract any large degree of popular support. John F. Dore was elected as Mayor and will succeed Robert H. Harlin, appointed by the Council to fill Mayor Edwards' unexpired term.

An amendment to the city charter abolishing the office of superintendent of public utilities was carried. Amendments affecting the municipal street railway were defeated, leaving that utility in the hands of the Mayor and Council.

North American Earns $3.41 Against $4.53 in 1930

The preliminary consolidated income statement of the North American Company and subsidiaries for the calendar year 1931 shows a balance of $22,452,916 for common stock after expenses, interest, depreciation and other reserves and preferred dividends. This represents a decrease in common-stock earnings of 16.85 per cent, compared with those for the year ended December 31, 1930. Earnings equal $3.41 per share on the average number of shares outstanding during the year, against $4.53 for 1930. Appropriations for depreciation amount to 11.45 per cent of gross earnings for 1931, against 10.67 per cent in 1930.

Gross earnings for 1931 totaled $117,921,860, against $133,751,380 for 1930, but these figures for 1931 do not include earnings for any part of the period of former California subsidiaries which were sold June 12, 1930, to Pacific Gas & Electric Company, while earnings for 1930 include those of the California subsidiaries for five months and twelve days to June 12, 1930.

It is of interest that the Potomac Electric Power Company of Washington, D. C., put into effect on February 1 the eighth consecutive annual reduction of its electric rates, effecting savings of about $860,000 to consumers. The reductions apply to all classes of service and in addition to a lower initial rate for all residential customers. The promotional type of rate provides further reductions based on greater use of electricity.

▼

Utility Financing Resumed

Ten-year 5½ per cent secured convertible gold bonds have been issued by the Virginia Electric & Power Company at 95½ and accrued interest to yield 6.10 per cent, a piece of financing involving a total of $4,000,000. Each $1,000 principal amount of these bonds is to be secured by $1,250 principal amount of first and refunding mortgage gold bonds of the company, series A, 5 per cent, due October 1, 1955. These bonds are to be convertible at the holder's option into a like principal amount of first and refunding mortgage gold bonds of the company, series A, 5 per cent, due October 1, 1955, at any time on or after March 1, 1933, and on or before the tenth day prior to maturity, or on or before the tenth day prior to the redemption date, if called for redemption, with adjustment for interest in each case. The company agrees to pay the holder upon conversion $50 cash per $1,000 principal amount of these bonds so converted.

A new issue of first mortgage and refunding twenty-year bonds, series C, was offered by the Virginia Public Service Company to the amount of $2,000,000, the price being 78, to yield more than 8¼ per cent. The company is a unit in the Middle West Utilities system.

Two offerings of bonds of subsidiaries of the Niagara Hudson Power Corporation were made during the week under review. The Syracuse Lighting Company, Inc., issued first and refunding mortgage 5 per cent bonds, series B, due January 1, 1957, at 95, to yield more than 5.35 per cent, a piece of financing involving a total of $5,000,000. The Utica Gas & Electric Company financing consisted of general mortgage 5 per cent bonds, series B, due January 1, 1952, at 93, to yield more than 5.55 per cent. Proceeds of both these issues will be used in the settling of certain indebtedness to companies in the Niagara Hudson system.

Blackstone Valley Gas & Electric Company made an offering of mortgage and collateral trust gold bonds, series B, totaling $2,000,000, the price being 91¼ and accrued interest to yield 5.69 per cent.

▼

North American Light Offers Rights

North American Light & Power Company has given to common-stock holders of record March 5 rights to subscribe on or before March 25 at $15 a share to additional common stock in the ratio of 8.14853 shares for each 100 shares held. Proceeds will be used to pay $2,000,000 of 4½ per cent serial gold notes which will mature April 1. The offering has been underwritten to the extent of $2,000,000 without commission by the Middle West Utilities Company and the North American Company.

▼

Electric Public Service Company in Receivership

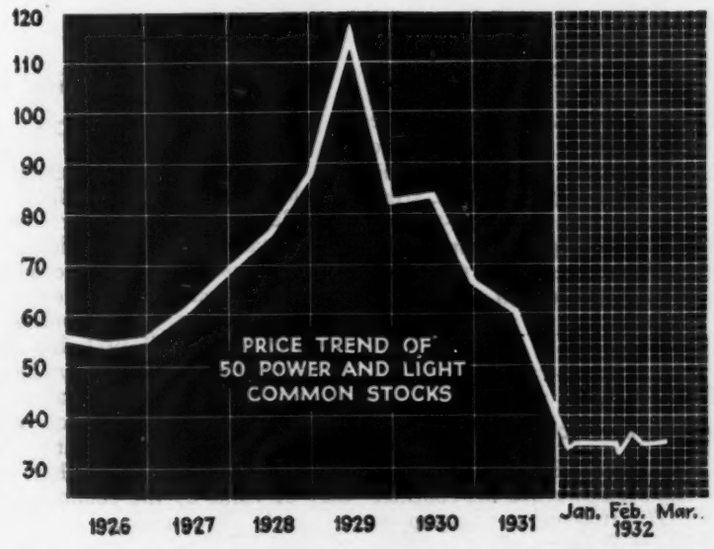
Herbert W. Briggs of New York and former Federal Judge Hugh M. Morris of Wilmington were named receivers in Chancery Court for the Electric Public Service Company of Philadelphia. The company supplies light and power to 150,000 persons in 88 towns in Ohio, Colorado, Oklahoma, Kansas and Texas.

The receivership was granted on the application of the Southwest Production Company, a subsidiary. Insolvency was admitted by the defendant company, which is controlled by the Electric Public Utilities Company, which in turn is controlled by the Empire Public Service Corporation.

All of the voting stock of the defendant company is owned by the Electric Public Utilities Company, for which Mr. Briggs and former Judge Morris are also receivers. The complainant company is a creditor of the defendant company, according to the bill of complaint, on a note for $250,000.

▼

Utility Stocks Gain Slightly



Continued strength in bond quotations is the most significant market factor this week. Both domestic and foreign issues have gained further ground on the average. Utility stock averages are up more than a point this week. Public Service of New Jersey and United Gas Improvement made gains of several points each.

Massachusetts Assists Rural Highway Lighting

In accordance with a special act of the last Legislature Massachusetts is conducting experiments in rural highway lighting, the first demonstration being made on the Salem Turnpike between Revere and Lynn—one of the most heavily traveled routes in New England. The road carries normally more than 13,000 vehicles per day and more than double that number on Sunday, and it is much used at night, particularly by trucks. The test section is approximately 2.3 miles in length. The roadway is four lanes wide with a bituminous macadam surface 40 ft. wide.

Fifty-five 4,000-lumen lamps in all are used, spaced 250 ft. apart, and staggered, at a height of 25 ft. Rippled bowl refractors, 8½ in. wide, throw the maximum amount of light upon the roadway. Telescopic brackets suspend the lamps over the highway 10 ft. from its edge. Full-length pressure-treated 40-ft. Southern pine poles supplied by the Century Wood Preserving Company support the brackets, and in some cases carry wire also.

▼

Radio City Awards Contract for Elevators

The Westinghouse Electric Elevator Company has been awarded the contract to install 76 full-automatic-equipped elevators in the 70-story office building which is to be the largest of the group of structures in the Rockefeller midtown building center, popularly known as Radio City, in New York. These elevators will handle the 13,000 persons, comprising regular tenants and their employees, in addition to a transient population of approximately 30,000 more persons, which will represent the daily quota of visitors to this building when it is completed. The approximate cost is $2,500,000.

▼

How Consumption Rises as Domestic Rates Shrink

BELIEF THAT the average citizen immediately uses more electrical energy in his home when he learns that rates have been reduced is borne out in just published figures, compiled by N. C. Albin, statistical engineer of the Illinois Commerce Commission. These figures show that in 1929 the 53 privately owned electric utility companies in Illinois received 5.88 cents for each kilowatt-hour of electricity sold for domestic purposes. In that year the domestic electric consumers in the state used an average of 518 kw.-hr. each. For 1930, the average revenue of these companies per kilowatt-hour was 5.61 cents, but each domestic consumer used an average of 567 kw.-hr., an increase of 49 kw.-hr.

This greater use of energy by domestic consumers is reflected to some extent in the earnings of the electric utilities for 1929 and 1930. In 1929 the 53 companies had a gross revenue of $168,315,461. In 1930, owing to consolidations and other causes, the number of companies in Illinois had shrunk to 44, which earned a gross revenue of $172,516,860. The total operating expenses of the 65 companies in 1929, exclusive of taxes and uncollectible bills, was $92,861,785, while in 1930 the total was $95,646,187.

▼

Determining the Price of Energy in London

A standard price for electricity in London has been fixed as from January 1, 1932, by the Electricity Commission and certain of the companies, and work is now in progress on the calculation of the ascertained cost of the companies on the 1931 figures. These prices will remain in force until 1971, but they may be varied by the Electricity Commission at any time on the application of consumers or companies, such variations remaining in force for at least three years, after which a further variation may be made by the commission.

Nearly all consumers in London are affected by these arrangements, but the idea prevailing among many electricity users that the actual price of energy is being fixed is not in accordance with the facts. The standard price is merely a criterion. Dividends of the companies, with one or two exceptions, are limited from January 1, 1932, to 7 per cent of the ordinary share capital, and the companies can distribute more dividend only to the extent of a sum equal to one-sixth of any amount returned to the consumers in the form of lower prices. It is clear, therefore, that in order to increase their dividend, even by a very small percentage, the companies must lower their prices.

In 1925 the London & Home Counties Joint Electricity Authority was constituted, composed of individuals drawn from various public and private bodies. Its main function is to exercise control over the supply undertakings in its area in order to see that they are efficiently and economically run and that the rights of the consumers as regards price and supply are safeguarded. The Authority can acquire any undertaking and can borrow up to $35,000,000 on favorable terms in order to compete with neighboring supply authorities. It is already supplying energy to eight big outlying suburbs and in bulk to six other important suburbs and five neighboring towns.

▼

Czech Electrification Making Headway

SATISFACTORY PROGRESS has been made with the plan to supply all sections of Czechoslovakia, rural as well as urban, with electric current, according to a report received in the Department of Commerce from Assistant Trade Commissioner Sam E. Woods at Prague.

The Ministry of Public Works, which grants subsidies for the work and is charged with the responsibility of carrying out the program, estimates that the consumption of electric current has increased by 15 to 20 per cent annually since the war. At the end of 1928 (the latest figures available) there were 529 electric generating stations in Czechoslovakia, of which 180 were operated in connection with industrial plants, according to the State Statistical Office. The year before that there were 457 power plants, of which 146 were in connection with various kinds of factories.

Total electric energy generated in Czechoslovakia during 1928 amounted to 1,990,000,000 kw.-hr., or 137 kw.-hr. per capita, as compared with 1,700,000,000 kw.-hr., or 117 kw.-hr. per capita, in the preceding year. The total length of transmission lines increased from 20,000 km. at the end of 1927 to 23,000 km. at the end of 1928, or about 15 per cent.

Although the Czechoslovakian consumption of electrical equipment and appliances has held up better than for most other lines, economic conditions have resulted in a reduction in the demand for

electrical projects. Sales of motors have been affected in particular, mainly due to the decline in the installations of new machinery in industrial plants and factories. Since the use of electrically operated household devices has been more or less restricted to the wealthy and well-to-do classes the decline in the demand for these articles has not been so marked.

Czechoslovakian imports of electrical equipment and apparatus dropped from 3,230 metric tons valued at 176,381,000 crowns (approximately $5,291,430) during the first seven months of 1930 to 2,431 tons valued at 151,005,000 crowns ($4,530,150) during the corresponding period of this year. This was a decline of nearly 25 per cent in quantity and about 14 per cent in value. On the other hand, exports rose from 2,061 metric tons valued at 47,743,000 crowns ($1,432,290) to 2,543 tons valued at $1,683,750, an increase of 24 per cent in quantity and nearly 18 per cent in value.

▼

Italian Utility Net Decreases Slightly

For the year 1931 the Italian Superpower Corporation reports a net income of $1,204,222, after charges, expenses, taxes, loss on foreign exchange and loss on sale of securities. This is equal, after dividends accrued on the preferred stock, to 41 cents a share on the combined class A and B common shares. Net earnings available for bond interest, dividends and surplus were $2,539,221, as compared with $2,578,540 reported for 1930. In 1931 eleven of the seventeen companies in which the corporation is interested paid the same amount of dividends as in 1930. One increased its payments, two decreased their payments and three omitted their dividends.

▼

New York Metal Prices

	Mar. 2, 1932 Cents per Pound	March 9, 1932 Cents per Pound
Copper, electrolytic	5.75	6-6¼
Lead, Am. S. & R. price	3.25	3.25
Antimony	6¼	6¼
Nickel, ingot	35.00	35.00
Zinc, spots	3.10-3.15	3.15
Tin, Straits	22.25	22.30
Aluminum, 99 per cent.	23.30	23.30

▼

Quebec Power Defers Dividend

Directors of the Quebec Power Company have decided to defer action on the common dividend usually payable April 15. On January 15 last a quarterly dividend of 50 cents was paid, prior to which the stock was on an annual basis of $2.50.

General Electric Votes 25-Cent Dividend

A dividend of 25 cents per share, payable April 25 to holders of common stock of the General Electric Company of record at the close of business hours March 18, was declared at the recent meeting of the board of directors of the company in New York. This action places the stock on a $1 annual dividend basis, against $1.60 annually since January, 1930. The regular dividend of 15 cents per share on the special stock of the company was also declared, payable April 25 to holders of record at the close of business March 18.

An abstract of the report of the General Electric Company for the year 1931 shows that the earnings on the common stock were $1.33 per share. In the fourth quarter 26 cents was earned. Sales billed in 1931 amounted to $263,275,255, compared with $376,167,428 in 1930.

Profit available for dividends for the year 1931 amounted to $40,956,996, equivalent, after dividends on the special stock, to $1.33 per share on 28,845,927 shares of no-par value common stock, compared with $57,490,915, or $1.90 per share, on the same number of shares in 1930. Dividends of 60 cents per share on special stock and $1.60 per share on common stock amounted to $48,725,262 for 1931, of which all but $7,768,266 was earned, this amount being taken from surplus. After this deduction, surplus amounted to $172,198,374 on December 31, 1931.

Cash and marketable securities amounted to $122,178,933 on December 31, 1931, compared with $141,717,851 of cash at the close of 1930. Total current assets amounted to $219,086,510, compared with total current liabilities of $28,482,788.

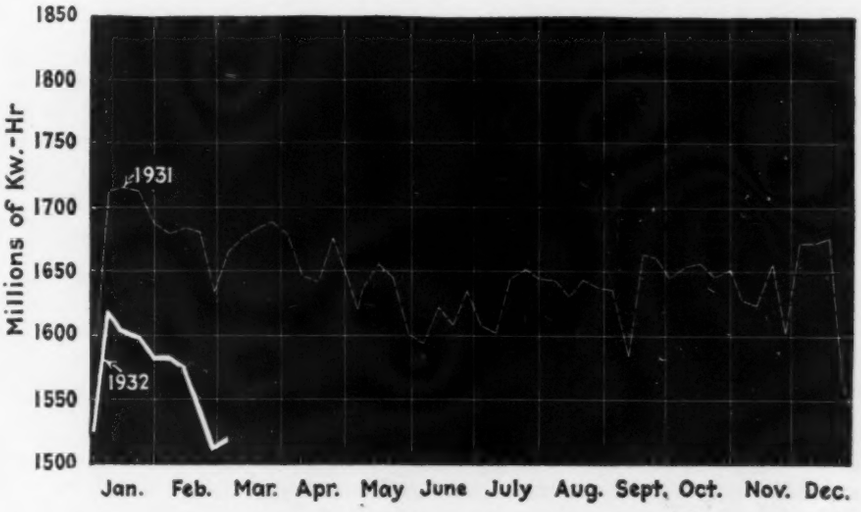
▼

McGraw Electric Earns 75 Cents a Share in 1931

For the year ended December 31, 1931, the McGraw Electric Company reports net profit, after all charges and federal taxes, amounting to $188,931, equivalent to 75 cents a share on 250,000 no-par shares, against $405,383, equivalent to $1.62 a share, in 1930.

▼

Weekly Output Rises Slightly



ENERGY output of electric light and power company plants rose slightly in the week ended March 5, but the increase was smaller than at the corresponding time of 1931 and the output was 8.7 per cent less. In the preceding week it was 7.4 per cent less than last year. Comparable data, as announced by the National Electric Light Association, are given in the accompanying tables.

Every region makes a less favorable showing, contrasted with 1930, than in the week ended February 27; however, in most of the areas the changes are so small that they may be due to differences in weather conditions and do not necessarily reflect industrial changes.

Weekly Output, Millions of Kw.-Hr.

	1932	1931	1930	1929
March 5	1,520	1,664	1,750	1,703
February 27	1,512	1,633	1,744	1,707
February 20	1,545	1,680	1,746	1,699
February 13	1,579	1,684	1,770	1,718
February 6	1,589	1,679	1,782	1,726

Per Cent Change from 1931

Region	Week Ended March 5	Feb. 27	Feb. 20
Atlantic seaboard	— 3.9	— 2.6	— 4.8
New England alone	— 3.2	— 2.5	— 4.6
Central industrial	—13.1	—11.7	—12.2
Chicago district	— 8.9	— 8.3	— 7.5
Pacific coast	—10.5	— 9.2	— 5.1

Why Drumm Battery Is Adapted to Transport

Probably the fullest description so far given in a public print of the Drumm storage battery now used to drive electric trains between Dublin and Bray in the Irish Free State is printed in the London *Times* of February 15 over the signature "Scientific Correspondent." This item says that the Drumm cell is "an alkaline battery, of simple, strong and inexpensive construction. Its positive plates contain essentially oxides of nickel, as in other alkaline batteries. The characteristic new features of the cell are comprised in the electrolyte, which contains dissolved zinc oxide, and in the nickel negatives which become coated with metallic zinc on charging." The writer continues:

The processes both of zinc electrodeposition and of solution during discharge can be carried out at high rates without any important loss of efficiency, and here can be seen the real advance made by Dr. Drumm. Briefly, he has produced a cell of considerably higher voltage than others of the same type, one whose specific normal discharge and charging rates are respectively four times and twice those of other cells, and one whose discharge rate can be further doubled or trebled for acceleration purposes without any difficulty. The efficiency at these high normal loads is very appreciably greater than that of similar existing cells working at lower rates. And there are positive reasons for anticipating that the cell will have a long life. In the battery designed for the train now being introduced on the Dublin-Bray service (14½ miles, eleven halts, fifteen to eighteen minutes spent at termini) the specific output per single cycle is low, perhaps 15 per cent of that of other alkaline cells. But with charging stations at the termini 20 cycles or more if required can readily be put through per diem, with the result that the specific daily output will be three times the usual.

This train has thoroughly justified in its trials the hopes of the inventor of the battery and others interested. Control is easy, speeds of 40 miles an hour are readily reached, acceleration is very rapid, and the particular qualities of the battery have permitted the successful use of a regenerative braking system, whereby the energy released on a down gradient or on halting at a station is utilized for charging the cells. This in itself is eloquent of the nature of the cells. For long hauls cells of modified design and of considerably greater single-cycle capacity can be used and the possibility will always exist of intermittent charging while running by occasional lengths of live third-rail.

The sponsors of this cell do not suggest that it will compete with existing batteries in any but certain at present relatively restricted fields. But they claim that, in virtue of its capacity for furnishing heavy currents, a number of transport problems hitherto closed to storage batteries can now be hopefully attacked.

▼

FROM DUBLIN TO BRAY AND BACK BY BATTERY

—*Wide World Photos*

Trains operated by the newly invented Drumm electric battery (*Electrical World*, December 12, 1931, page 1029) have a businesslike appearance and bear the bilingual signs which are a feature of Irish Free State cities.

Gas Industry Answers Electric Range Challenge

Following the announcement that power companies and manufacturers of electric ranges are pledged to a three-year program, involving an expenditure of $12,000,000 for advertising and promotion, comes the statement that gas utilities and makers of gas ranges will parallel the educational campaign with one of their own. The keynote was sounded in an address delivered before the manufacturer's section meeting of the American Gas Association by W. Frank Roberts, president of the Standard Gas Equipment Corporation, New York.

Stating that gas ranges of today are far advanced over those made just a few years back, Mr. Roberts said: "Here is a situation demanding immediate action. The manufacturer of gas appliances, as well as the utility whose chief income is derived from the sale of gas, must recognize the obligation imposed by this move on the part of the electrical interests. We must re-emphasize the superiorities of cooking with gas and point the way to a public bewildered by the conflicting claims.

"It is far from our thought to eliminate the electric range. This youngest of electrical appliances will have a definite place in some homes. But the vast majority will always consider cooking with gas as the ultimate modern method. For gas is cleanly, intensely hot and far more economical than any other fuel, especially when used with modern ranges, such as we will release for general display within a short time."

It is said, on good authority, that the Standard Gas Equipment Corporation is asking the gas range manufacturers to sponsor a movement which will combine gas range manufacturers and gas utilities in a group to meet the competition from the electric range.

▼

General Electric Reduces Relief Contributions

Employees of the General Electric Company, who since November 1, 1931, have been contributing 2 per cent of their average full-time earnings toward the relief of part-time workers and the unemployed within the company, will have but 1 per cent deducted from their pay, starting March 1, according to announcement by President Gerard Swope.

During this four-month period employees have contributed approximately $480,000, which has been matched dollar for dollar by the General Electric Company, making a total of $960,000. During the same four months approximately

$593,000 has been paid out to employees of the various apparatus works, leaving a balance in the fund on February 29 of $367,000.

"While the estimates of the monthly amounts to be paid out for March and April, the last two months under the six-month plan adopted last fall to assist employees during the winter months, are greater than for the preceding four months, the indications are that, with the surplus on hand, contributions of 1 per cent during these two months will be sufficient to meet the employment guaranteed," Mr. Swope explained.

The $960,000 contributed to this fund does not include approximately $1,000,000 collected and distributed among employees during the ten months preceding November 1, 1931, under the Swope unemployment insurance plan adopted December 1, 1930. One-half of this million dollars was contributed by employees and the other half by the company.

▼

Large Order for Ranges

Justifying a recent statement made by C. E. Allen, commercial vice-president of the Westinghouse Electric & Manufacturing Company, to the effect that an increase in the company's merchandising business was anticipated in 1932, announcement is made of one of the largest electric range orders received in the past few years.

This order, according to Reese Mills, manager of the range division at Mansfield, Ohio, calls for 2,000 electric ranges and was received from the Alabama Power Company, the Georgia Power Company and the Tennessee Electric Power Company, all properties of the Commonwealth & Southern group. The order is for immediate delivery.

▼

Home Refrigerators Assume Leading Rôle as Load Builders

AS A potential load builder household refrigeration is assuming a rôle of arresting importance. Current statistics disclose enormous possibilities for expansion over the next ten years as the public becomes more and more sold on the refrigeration idea. The subject is creating keen interest among central-station executives.

To any one resident in an advanced community it may seem that the household refrigerator market is pretty well saturated. This is far from true. Today there are some 3,500,000 household refrigerators in use in the United States. The number of wired homes is now approximately 20,441,000. The existing market of wired homes is thus only 17 per cent saturated. This indicates the magnitude of the potential market as the addition of refrigerators is promoted in the other 83 per cent of wired homes and as the balance of unwired homes is gradually reduced to a minimum.

The average refrigerator load is around 600 kw.-hr. annually. In the past three years alone 2,640,000 refrigerators were sold out of 3,500,000 already stated to be now in use. These refrigerators account for 2,100,000,000 kw.-hr., or 2.3 per cent of the national total. Considering only the domestic load, refrigerators account for 17 per cent. Assuming the addition each year of only the number added in 1931, and disregarding obsolescence, there would be in use as of December, 1934, 6,350,000 units, which would account for 28 per cent of the total domestic load projected at the present rate of increase. With the low degree of saturation now existing it is highly probable that the rate of increase may be much greater and that the load-building importance of refrigerators will assume proportions beyond present expectations.

▼

Reorganization of National Pole & Treating Company

The National Pole & Treating Company, Minneapolis, has successfully refinanced $2,000,000 in gold notes which matured on December 1, 1931. The management of the company has been reorganized. E. W. Backus and S. W. Backus, respectively chairman of the board and president of the company, have both withdrawn from their official positions with the company in order that they may devote their entire time to problems connected with the operations of the Minnesota & Ontario Paper Company, and hereafter they will have no part in the management of the National Pole & Treating Company.

In the reorganization R. H. M. Robinson of New York City, Charles R. Fowler, attorney of Minneapolis, and W. A. Durst, president of the Minnesota Loan & Trust Company, have been elected to the board and with G. H. Ramsey and L. A. Furlong will constitute the directors of the company. Mr. Robinson has been elected president, and Mr. Ramsey and Mr. Furlong will continue in the capacity of vice-presidents in direct charge of the operations of the company, Mr. Ramsey being in charge of the pole department and Mr. Furlong being in charge of pressure treatment, railroad ties, posts and piling. Former high standards of quality and service will be maintained and the facilities of the company extended.

▼

Reliance Elevator Company Gets Large Contract

Said to be one of the largest contracts for elevators ever placed, the Reliance Elevator Company, St. Joseph, Mich., has secured an order for 308 passenger and freight elevators for two fifteen-story pier and terminal buildings to be constructed by the International Terminals Corporation, Boston, Mass., on Dorchester Bay, totaling $3,000,000. Work on the units is being placed under way at once.

Major New Construction This Week

THE Southern Sierras Power Company will install high-voltage equipment in four main power substations, Imperial Valley district, including regulators, transformers, switching apparatus and accessories. Total about $125,000.

Electric machine drives, motors, controls, panelboards, motor-driven conveyors and miscellaneous electrical equipment, costing over $50,000, will be installed in new central lead and zinc concentrating plant of Eagle-Picher Mining & Smelting Company, Picher, Okla.

More than $350,000 will be expended by Industrial Rayon Corporation, Cleveland, Ohio, for four new plant units; electrical installation to include machine drives, heavy-duty motors, control equipment, panelboards, industrial lighting apparatus and accessories.

Electric machine drives, motors, controls, panelboards, motor-driven conveyors and miscellaneous electrical equipment will be installed in $75,000 mill addition at Edgely, Pa., of Paterson Parchment Paper Company, Passaic, N. J.

Electric-operated refrigerating machinery, heavy-duty motors, controls, panelboards, conveying and loading equipment, elevators and auxiliary equipment costing $50,000 will be installed by John Morrell & Company, meat packers, Ottumwa, Iowa.

Motor drives, controls, panelboards, conveying equipment and accessories will be installed in new $200,000 mill to be constructed by Acme Hosiery Mills, Inc., Asheboro, N. C., and occupied by McCrary Hosiery Mills, Inc.

Electric-driven elevating, conveying, screening, drying and other machinery, with heavy-duty motors, controls and accessory equipment costing close to $40,000 for grain elevator of Missouri Pacific Railroad at Kansas City, Mo.

Marking Obstructions to Flying

Progress is reported in the organization of an American Committee on the Marking of Obstructions to Air Navigation in which the N.E.L.A., the N.E.M.A., the A.I.E.E. and about ten or twelve other technical associations will be represented in combination with the Aeronautical Chamber of Commerce of America. E. C. Stone, Duquesne Light Company, Pittsburgh, is chairman of the executive committee of the projected joint body. The committee purposes to study the technical questions in its scope and to prepare standards.

▼

Michigan Expansion in 1931

Extension of power-system lines in Michigan during 1931 took electricity to 27 communities which had not previously had service from central stations, according to a report issued by the Utilities Information Bureau. The 27 communities include ten resort settlements, some of which have a considerable all-year-around population. During the year nine Michigan towns changed in whole or in part from municipal electric service to utility system service.

▼

St. Louis Saves in Street Lighting

About $35,000 a year is to be saved in St. Louis, city officials announce, by reducing the size of lamps in a large downtown area, cutting 2,500-cp. units to 1,500 cp., 1,500 cp. units to 1,000 cp. and so on. The economy will affect the section bounded by Jefferson, Cass and Chouteau Avenues and the river, where there are 3,839 lamps.

▼

P. G. & E. to Rebuild Small Plant

Plans for the early reconstruction of its Potter Valley power house, about 15 miles northeast of Ukiah, Calif., have been announced by the Pacific Gas & Electric Company. An 8,500-hp. hydraulic turbine and a new generator will replace two 2,500-hp. generators designed 23 years ago, and additions will be made to the interior equipment. Installed capacity will be increased to 16,750 hp. and efficiency from 46 to 86 per cent.

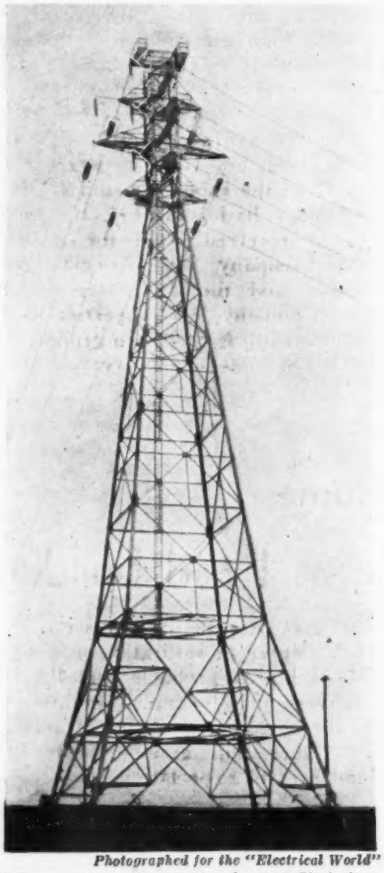
▼

To Erect Village at Safe Harbor

Contract has been awarded by the Safe Harbor Water Power Corporation for building an operators' village in connection with its new hydro-electric development on the Susquehanna River at Safe Harbor, Pa., and 25 buildings will be erected on the ridge overlooking Conestoga Creek. These are to include 21 single-family brick cottages, an apartment house, bachelor quarters, a dormitory and a dining hall. The village project will cost more than $300,000.

▼

TRINITY RIVER CROSSING



Photographed for the "Electrical World"

When the channel of the Trinity River at Dallas, Tex., was moved recently to make room for a new industrial development, the Dallas Power & Light Company built this transmission-line river-crossing tower. It is 215 ft. high with a span of 2,221 ft. and a sag at 120 deg. F. of 122½ ft.

▼

Wisconsin Rule on Deposits

A complaint against the action of the Wisconsin Valley Electric Company in applying a deposit made by a customer for electric service to indebtedness for appliances has been sustained by the Wisconsin Public Service Commission, which says that such funds cannot be so absorbed. "When a utility engages in activities involving merchandising and jobbing, it is a well-recognized legal and economic principle," the commission observes, "that such activities should be completely divorced in so far as it is possible from the regular utility activities." Sums owed for merchandise can be collected in the ordinary manner.

Utility to Electrify Denver's Pumps

Denver's municipal water system is to be electrified, displacing the present steam pumping plants. A contract calling for complete change-over within two years was signed March 1 by the Water Commission of the city and the Public Service Company of Colorado, which will furnish the power. Three of the city's pumping plants, now partly electrified by municipal generating plants, are to be supplied with energy from company lines by April 1. The entire program contemplates an expenditure of $1,500,000, to be paid out of earnings.

▼

Puget Sound P. & L. Rates

Commercial lighting rate reductions have been filed by the Puget Sound Power & Light Company with the Washington Department of Public Works in two schedules, one for eastern and one for western Washington. These supersede 35 former schedules and will bring an estimated annual net saving of $94,000 to customers.

▼

Winnipeg River Rentals

A new basis for rentals for the various plants developing hydro-electricity on the Winnipeg River is under discussion. The Manitoba government also wants these plants to bear a part of the cost of constructing storage dams at Lac Seul and Lake of the Woods. It is intended to bring all water-power development under Dominion regulation. The city of Winnipeg's 20-year lease on the Pointe du Bois site expired last November. This gave the civic plant exemptions on the first 20,000 hp. developed, and the charge for excess energy was on the basis of 50 cents a horsepower. The government now wants the civic plant to pay 50 cents for all energy developed. Civic authorities are strongly opposing this measure.

▼

Nebraska's Initiated Law Suffers

Nebraska municipal ownership forces have suffered a reverse at the hands of the voters of the city of Geneva, who rejected by a vote of 671 to 276 a proposal to oust the Iowa-Nebraska Light & Power Company, which has served the city for many years, and construct a municipal electric plant. The election was one of the first tests of the initiated law adopted in 1930 at the instance of the Nebraska League of Municipalities, headed by Attorney-General Sorensen. The proposal was to pay for the plant out of future earnings. Many citizens held that it was unfair to destroy a private investment of $150,000.

Stainless Steel Yields to "Shot-Welding" Process

A new welding process which for the first time permits the joining of stainless-steel sheets without setting up conditions which will lead ultimately to distructive rusting has been developed by the Edward G. Budd Manufacturing Company. The process has been used in constructing an airplane and the just-announced Budd-Michelene lightweight railway car. This method has a potentially wide application to many fields of fabrication practice and is known as "shot-welding." Stainless steels of high tensile strength—containing 18 per cent chromium and 8 per cent nickel—are so tough that fabrication with rivets is uneconomical, and when welded the heat of the electrodes separates the chromium and forms a spot which is subject to destructive rusting.

"Shot-welding" is spot-welding under highly accurate current, time and pressure control with several radical features. Instead of taking the work to a spot-welding machine, the operator carries a pair of tongs, each lip of which forms one electrode. A helper just ahead of him clamps the sections together with a pneumatic clamp. The welder applies his tongs, and the weld is complete. The secret is high current—in one case 1,200 amp. for material $\frac{1}{32}$ in. thick which acts so quickly that the stainless steel does not have time to lose chromium. A time switch, acting on the same principle as the automatic center punch, may be set to vary the time of current application from 0.01 to 0.001 second—no matter how long the welder holds his tongs on the weld. Cables from the welder's tongs extend to portable transformer boxes carried by shop cranes.

Weld strength is said to be at least as strong as the parent metal, for finished welds will stand a 90-deg. twist before parting, or a jerk that tears out the spot.

▼

Electrical Oscillations as a Source of Music

Probabilities of utilizing as sources for musical effects of the highest quality, satisfactory alike to layman and skilled musician, the electrical oscillations which when properly produced and controlled not only simulate present orchestral instruments but give new and interesting characteristics of their own continue to come closer.

At a recent meeting of the New York Section of the American Institute of Electrical Engineers "theremins" of the space, keyboard and fingerboard types were demonstrated for both simple and complex effects; the "Ranger" tone-electric organ (which was illustrated in the ELECTRICAL WORLD for July 4, 1931, page 6) sent a program by wire to the auditorium, and the "Meissner" electronic organ-piano, which picks up the sounds from the vibrating strings of a wholly inclosed piano and amplifies and converts them into new effects, was also demonstrated.

With such outstanding musical authorities as Walter Damrosch and Leopold Stokowski showing great interest in such devices and utilizing them in their orchestras, it would appear to the layman that the artist's acceptance of new musical instruments based upon the electron tube was well on the way.

▼

Praise Instead of Scoffing

A rather unusual happening in the world of electricity—praise of private-company methods by a municipal-plant manager—is reported from New Britain, Conn., where a Consumers' League, formed to bring about the abolition of a fixed or area charge by the Connecticut Light & Power Company, recently asked A. L. Pierce, general manager of the Wallingford (Conn.) municipal power plant, to address its members. Mr. Pierce, who has 45 years' experience in the electrical industry, probably surprised his audience by praising instead of criticising the utility named and by justifying a service charge and explaining its object.

Welding Problems to Be Studied, Results Applied

Fundamental research problems in the welding art upon which action is needed have been segregated according to various classifications in a list just compiled by the fundamental research committee of the American Bureau of Welding. This bureau is a joint research board affiliated with the American Welding Society and the National Research Council.

The classifications adopted in the suggestions are those involving physical tests, metallurgical experience, problems in physics, welding procedure, structural studies, chemistry and psychological factors. The list covers 50 topics about which either insufficient fundamental information is available or as to which considerable and notable difference of opinion exists.

The committee consists of representative scientists of industry and also of professors interested in fundamental welding research. The results of its recommendations will be first shown in the stimulation of interest in and initiation of such investigations on the part of various universities and will be ultimately reflected in industrial practice. A list of such problems is compiled and distributed each year. The bureau cooperates wherever possible but has no dictatorial function.

▼

HOW PHYSICISTS TRACE THE PATH OF ELECTRONS

—*Wide World Photos*

Dr. J. W. M. DuMond of the California Institute of Technology has constructed a multi-crystal spectrograph which registers the path of ricocheting X-rays sent crashing into electrons. The rays originate in the tube to DuMond's left and strike the battery of graphite crystals in the foreground, thence being deflected into the "vanes" of the spectrograph.

EDITORIALS

L.W.W.MORROW
Editor

A time to do and dare

THIS country was built by men who took a chance. Great industries were never created by conservative business men or bankers. What this country needs now is a few dominating, speculating buccaneers who do things. As General Harbord said recently, America seems to be a hypochrondriac "shivering with financial heebee-jeebees." Prosperity can never be starved back to health, nor can progress be made by a program of inertia. The time is passed for "Let George do it" action. Congress has used all the hypodermics available. Prosperity must be bought back by the use of purchasing power.

Money aided and abetted the reckless extravagance and high-power salesmanship that got us into this mess, and yet money is reluctant to do its share of work to bring capacity back to normal. Supercaution in credit is putting a halter on industry despite the congressional measures of inflation.

Every individual, every industry and every business enterprise needs to go to work to buy back prosperity. It is time to cease cutting production, stopping purchases, reducing inventories and firing men. It is time to fill shelves barer than those of Mother Hubbard in manufacturing, jobbing and retailing. It is time for banks and chief executives to afford credit to utility and industrial operators so that they may buy, expand, sell and build. A little loosening of purse strings, a little liberality, a little confidence, a little gambling if you please—these may buy back prosperity. If America does not do these things, then it had better prepare a big bread line and try starvation instead of credit as an inspiration for courage and progress.

Investigation of investment trusts

CONSIDERABLE study of management investment trusts has been made by Attorney-General John J. Bennett, Jr., of New York State, and this has caused him to conclude that many of their practices are fraught with danger to investors. He has recommended a legislative investigation and has started proceedings against nineteen trusts under the Martin stock fraud act. Of 100 investment trusts examined, 44 were found to be satisfactory and 56 open to criticism.

Practices condemned by Mr. Bennett are briefly stated as follows:

1. Diversion of investment funds to the purchase of securities in which trust officers and directors are interested.
2. Borrowing and loaning funds in excess of capital and surplus.
3. Borrowing with insufficient or no collateral from the funds by officers or directors.
4. Payment of dividends when not earned.
5. Repurchase of the investment trust's own securities out of capital to maintain market prices.
6. Making affiliations with banks or brokers to conduct marginal stock market operations.
7. Concealing actual conditions in annual statements.

There are 227 management investment trusts doing business in New York, with total resources of $4,473,000,000. The practices outlined by Mr. Bennett are unsound, especially when pursued by the investment trust that owns and manages subsidiaries, and the proposed investigation and injunction proceedings will clear the atmosphere

for the sound institutions. Management investment trusts are needed and essential, but they are almost in the same category as insurance companies, and legislation to protect the investors as well as the legitimate enterprises is warranted and needed.

Practical aspects of taxation on electrical energy

UNDER the new tax bill reported to the House of Representatives by the ways and means committee electricity definitely becomes a commodity of manufacture. As such it is subjected to the 2¼ per cent tax on its sales price. The administration is thus going through with the sales tax in a herculean effort to balance the budget. The question no longer seems to be whether the innovation will vitiate the helpfulness of credit stabilization and the buying confidence which it bids fair to foster. The questions, at least for the electrical industry, are, how will it be applied and what will be the consequences?

Utilities and municipalities which generate will find that the assessment amounts virtually to a percentage of gross income, because so little revenue is derived from other sources than energy sales. Those who merely transform and resell will face the tax in their purchase price and there will thus be no pyramiding. Two obstacles arise at once in the regulated and contractual arena of the utility enterprise. Must the producer absorb the tax because he is obligated to adhere to contracts which make no provision for passing on such an impost to the purchaser? In the case of schedules filed with public service commissions must sanction be asked for adding the tax to all bills—residential, commercial, industrial, wholesale, and municipal when the last named are for resale? If discrimination and months of delay are to be avoided, this tax should be applied as a federal mandate superior to and exempt from commission jurisdiction.

These are the features which differentiate utility service from the general field of manufactures. In the latter case it appears that the ultimate sale price of the commodity can readily be adjusted to absorb the tax. In the former the rigidity of the regulatory and contractual restraints tend to prevent such transfer of the tax incidence. To the utility it becomes a serious matter because 2¼ per cent of gross income amounts to some 10 per cent on the net. Other taxes already take 20 cents out of every net dollar; 10 cents more means survival or catastrophe—unless more drastic retrenchment is to be the result. If electricity could not be exempted, why should not the new tax bill have treated power currents like voice currents, not as commodities, but as services, and correspondingly have prescribed assessment on the user's usage rather than on the producer's production? The distinction between power megamperes and telephone milliamperes is far less than between electric power and, say, razor blades and radio sets. The tax should have been stipulated as a direct extra on the consumer's bill for electricity just as for telephone service.

Merchandising at a loss

UTILITIES are anxious to develop the domestic market rapidly. Executives put the burden upon the merchandising departments and expect them to do this at a rapid rate and yet make a profit as merchants. This cannot be done at present. The margins on appliances are too low and the competition with other services is too keen to permit of high-pressure selling at a profit. No dealer or utility merchandising department can make money if the attempt is made to increase sales volume rapidly. The greater the rate at which business is gained, the greater the merchandising loss.

This is the fault of the present merchandising system and it cannot be changed overnight. Conditions undoubtedly will be improved, but, at present, utility executives cannot have their cake and eat it. They must take a loss as merchants and realize profits only from increased use of energy. The profits should be far greater than the losses at the balance point.

The dealer cannot sell at a high-pressure rate and make money. This is not his fault, but he should not begrudge immediate business to the utility that sells despite merchandising losses. The dealer and the utility, however, should work together to get the merchandising business on a plane that will enable them to make money. They should put it up to the manufacturer and jobber to help them improve the system. It can be improved.

Continuity in research

STEADY pressure upon the unknown must be maintained by the industrial research laboratory to realize the best results. At the height of the boom period a few years ago a major portion of such activity was concerned with the rapid solution of problems of immediate engineering necessity. As conditions changed and the pressure of immediate urgency relaxed, a smooth transfer of emphasis to attack fundamental problems involved with the future of communication took place in the Bell Telephone Laboratories, and indeed in other institutions of inquiry closely related to engineering and operating tasks.

Dr. Frank B. Jewett recently pointed out that without a flexible organization or with a group of narrowly trained specialists this transfer could not have been effectively made. In the face of stupendous changes in the general economic structure it is fortunate that those in charge of organized research work in so many cases determined to adapt it to the opportunities of the depression period and that so many American industrial executives voted the necessary appropriations to keep research work from falling by the wayside. The organization of a modern large industrial research laboratory is far more than an aggregation of specialists. It is, in fact, an association together of a goodly number of broadly trained, intellectually competent individuals capable of attacking effectively a wide variety of problems. Continuous utilization of such massed ability is more than warranted, for the time factor in research is vitally important in relation both to inspiration of personnel through contact and to the attainment of early goals.

Relays are quicker than the airplane

LIGHTNING moves with lightning speed. Air travel is in the high-speed class. Lightning frequently interrupts power-transmission circuits, and airplanes have done so in two or three instances. For these and other interferences the electrical engineer has devised protective measures which likewise have attained high speed in functioning. But it conveys little information to the layman to say that the line and the fault can be cleared in six or eight cycles.

It may actually be as surprising to many electrical engineers as to the aforesaid layman to learn that modern power-line relays and circuit breakers were fast enough to "kill" a 220,000-volt circuit on which an airplane had created a short circuit across two wires before the plane's 120-mile-an-hour speed could bring it to the third wire. That one-ninth of a second might be of little benefit to the aviator, but it does mean much in preventing wreckage of power-system equipment when energy tends to pour into the faulted location.

Purchasing and selling

BOTH purchasers and sellers have problems and points of view. In the broad sense the problems are the same and should be solved by a common method and the points of view should be focused. But in every-day transactions of human beings it is difficult to deal in principles, and the result is that sellers call purchasers "hard-boiled" and purchasers call sellers "Shylocks."

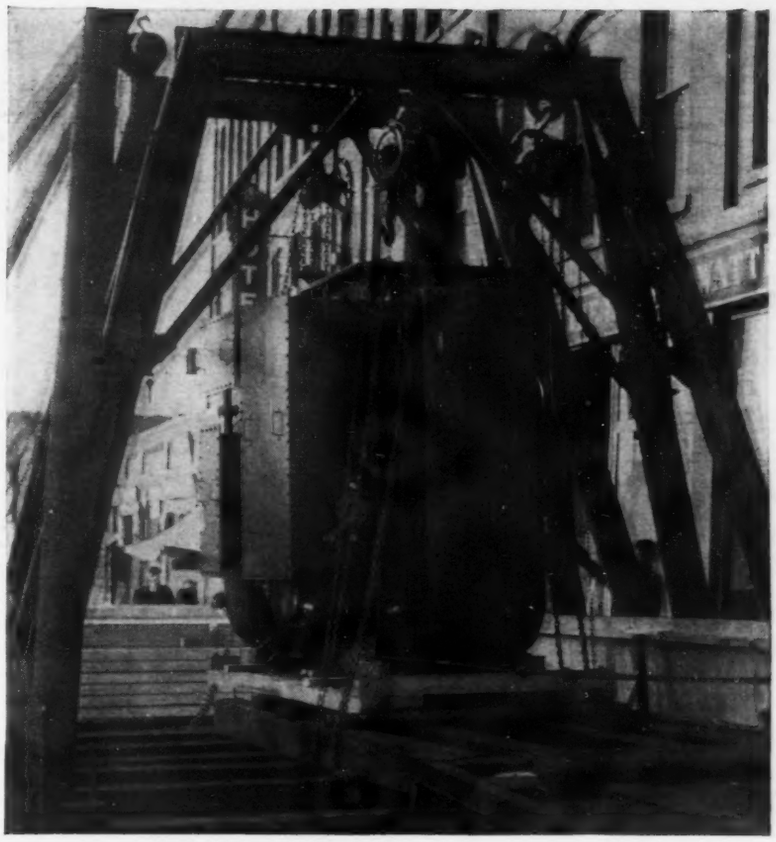
These things were discussed recently at a meeting of utility purchasing agents. They agreed on the general principles that any seller is entitled to a fair profit, that stable prices should be maintained and that business should be conducted on a high plane of ethics. They resented being called "hard-boiled" or "auctioneers," and rightly so. The purchasing agent is just as human as any one and just as high-principled, but he acts as only one agency in a complicated commercial mechanism. He does not control or establish the methods by which sales are carried on, nor can he establish business ethics for the other agencies necessary in business transactions. Purchasing agents are correct in their claim that the sellers are equally, if not more, responsible for the ethical conduct of business and for present-day business practices.

What is the answer? Experience indicates that two groups can work out a common problem and understand each other's point of view if they can come together, get acquainted and discuss their differences and agreements in a common forum. This can be accomplished in joint meetings, by making individual programs that incorporate discussions by the other group and by making opportunities available for getting acquainted. These things should be done because they will result in improved business conditions.

Networks Not Confined to Large Cities

THE Pittsfield Electric Company was recently faced with the necessity of providing additional capacity for supplying 4,000-volt distribution in the city of Pittsfield. It was decided that the installation of a primary network system offered marked advantages over the alternative of building a new radial substation along conventional lines. Four 1,500-kva. (2,000 kva. with forced-air cooling) vault-type primary network units have been installed and interconnected to form the network.

The units are installed in underground vaults 9 ft. wide, 29 ft. long and 10 ft., 6 in. deep, which were completely finished before the apparatus was installed.



The roof was built of concrete slabs resting on removable I-beams, permitting its complete removal with comparative ease. The units were received from the manufacturer in two sections, the switchgear being separate from the transformer to facilitate handling. The switchgear portion was first transported to the vault location on a trailer and lowered into its permanent position by means of tackle suspended from two "A" frames, fabricated from standard steel channels. The transformer was transported and lowered into the vault in a similar manner. Its position was adjusted to align properly with the switchgear and the manufacturer connected the two portions together, forming a single, completely submersible metal-clad unit.

Wisconsin's Latest Steps in Utility Regulation

By DAVID E. LILIENTHAL

Public Service Commission of Wisconsin, Madison, Wis., and Formerly of the Chicago Bar

"Electrical World" asked Mr. Lilienthal, as a member of the Public Service Commission of Wisconsin, for an unofficial statement on the revitalized program of regulation in that state. As justification for such request it was pointed out that since much of the pioneer and notable work of public utility regulation has been done in Wisconsin the changes in regulatory law and administration effected during 1931 are matters of national interest.

IT SEEMS to be generally conceded that public utility regulation in Wisconsin, as elsewhere, has suffered in prestige during the past decade. Whether this is due to a general lowering of the standards of public administration in all fields of government activity during this period, whether it is due to the increased difficulties of regulation because of the holding company situation or of the speculative boom, or whether the criticism is justified at all it is not essential at this point to inquire. The fact seems to be clear that public confidence in utility regulation has been weakened.

Since the inauguration of Governor LaFollette in January, 1931, Wisconsin has undertaken to revitalize and revive effective regulation. In an effort to make regulation more effective the state's legislative and executive branches have followed three major courses:

1. It has been recognized that the commission's staff must be adequate both in quantity and quality for the greatly increased responsibilities which have fallen to it during the past fifteen years. This carries with it a need for increased funds for the work of the commission.

2. The Legislature and the Executive have recognized that the statutes from which the commission derives its powers must keep step with recent changes, both industrial and social.

3. The commission as reorganized under the present Governor has taken the view that it must emphasize its administrative and inquisitorial powers as distinguished from its judicial powers. At the same time the commission has insisted that the principles laid down for regulatory bodies by the late Senator LaFollette should not be departed from, namely, that the commission should not be guided in its determinations by public clamor or by insistent but uninformed and unbased claims, but that it should decide its cases upon the records before it, making certain, however, that the records are complete and trustworthy, and that the consumer's side is adequately prepared and presented.

Commission finances and staff personnel

An able and fair-minded counsel for utility interests has recently pointed out the critical importance of an adequate appropriation and competent staff, if regulation is to be successful. Speaking before the American Academy of Political and Social Science in November of 1931, William L. Ransom of the New York bar said:

> No governor or legislative leader has a right or reason, in my judgment, to lament or denounce any insufficiencies of state regulation until he has brought it about that the commissions are equipped with competent and independent staffs, adequate in size and sufficiently well paid to attract and hold men and women of first-grade ability. Engineers, lawyers and accountants, as well as commissioners, should not be expected to deal efficiently and courageously with vast corporate properties if all the time these guardians of the public interest are left without the means of maintaining a comfortable standard of living and educating their children . . . If there is any "failure" of regulation in these states, it is truly a failure of appropriations, for well-staffed regulation has not been tried. If the budget makers of a state choose to have the public interest as to utility rates or securities safeguarded only by a $2,000-a-year lawyer and a $1,200-a-year engineer fresh from college, the fault is hardly that of the regulatory law or system.

It has for some time been the view of the writer that a competent staff, acting under public-spirited and courageous direction, is more important than any other single factor in making regulation achieve its purpose of pro-

tecting the public interest. In years past some of the soundest and most scientific analysis of the problems of utility regulation and operation has come from the Wisconsin commission, and many of the staff members in a large measure responsible therefor have subsequently taken posts of great responsibility in the public utility industry. Their names are familiar: Halford Erickson, Gruhl, Hagenah, Doolittle, Strait, Reyer, Sloan and dozens of others in all parts of the country. Immediately upon taking office in April, 1931, the writer, with the active approval of his colleagues and the encouragement of the Governor, set out to find and bring to the Wisconsin commission staff outstanding technical men with the necessary public point of view, regardless of their residence, politics or previous connections. In this quest the commission has been singularly fortunate. A large accounting department of qualified men has been built up because of the commission's feeling that it is in the realm of accounting control that simplicity and expedition in regulation must be looked for. A new department of rates and research was established and manned with men of sound training and experience. Salaries have been paid in excess of those customarily offered in state service, to attract the ablest type of men. A new post, that of chief examiner, was created, and to it was appointed George C. Mathews, for years chief statistician of the commission and one of the ablest men in public service in the country today. His duties are analogous to those of a people's counsel.

Statutory revision

The 1931 Legislature passed a considerable number of new laws and amended many others respecting the regulation of public utilities. There are bound to be differences of opinion as to their soundness and probable effectiveness. But that they were drafted, passed and signed in a sincere belief that they would strengthen public control and lead to a revived public confidence in regulation of utilities there can be no doubt.

It has unfortunately been true in some parts of the country that public regulation has been stoutly defended by public utilities in the abstract, but when specific proposals looking toward the strengthening of regulation have come before the Legislature the public utilities have done everything in their power to defeat such measures and have offered no constructive programs themselves. As to the electric utilities, at least this has not been the situation in Wisconsin.

Before the administration's bill for the regulation of public utility statutes was introduced it was submitted, in conference, to counsel and representatives of the utilities for criticisms and suggestions. They disagreed on a number of matters of policy. But from the electric utilities there was no blind opposition or mere obstructionism. Some of the criticisms were deemed by those in charge of the measures to be well taken and drastic changes made in the proposed measures. The bills were then introduced, with some of the features regarded by the utilities as highly objectionable still in the measures. They were then the subject of conference with the commission, and after open and frank discussion further changes were made. When the final hearing was held upon the bills the electric utilities of the state appeared in favor of the measures in principle, although they represented perhaps the longest step in regulatory law taken in any state in many years.

I have thus stated, in what may seem to be inexcusable detail, the process whereby these bills became law, because the process is almost as significant as the laws themselves. Obviously, many of the utility representatives believe neither in the policy nor in the wisdom of some of these measures. But they probably realized that if regulation is to continue there must be experimentation and growth, and this experimentation must often be in directions which utilities regard as unsound. They must have realized that to proclaim their belief in regulation, and yet to fight bitterly against all changes or claimed improvements in the legal or administrative basis of regulation, would arouse justifiable suspicion as to their good faith and a loss of public confidence.

How the electric utilities are affected

While the changes in the public utility statutes included many subjects, those of chief interest to the electric industry generally relate to (a) holding company control, (b) depreciation, (c) control of construction and, finally (d) the assessment of the costs of investigations against the utilities.

The 1931 Legislature did not attempt to vest the Public Service Commission with jurisdiction over holding companies. The theory of the legislation was that by giving the commission a stronger hold upon the operating company in its relations with affiliates whatever abuses were attributable to holding companies could be controlled. Therefore, public utilities are required to submit for commission approval contracts or arrangements with affiliates (a term which is broadly defined), and it is incumbent upon the operating company to furnish proof of the cost to the holding company of the services or commodities which are the subject of such contracts or arrangements. An attempt was made, the first, so far as we know, to require foreign holding companies to consent to be sued in the Wisconsin courts.

The commission has proceeded, in the enforcement of this new law, by issuing a questionnaire calling for a statement showing affiliations with other companies and for copies of interaffiliate contracts. Beyond this little occasion has yet arisen for the exercise of this new jurisdiction.

The first comprehensive statute on the subject of depreciation was enacted by the 1931 Legislature. This act, in effect, makes depreciation accounting, as distinguished from retirement accounting, mandatory. Public utilities are required to submit their "estimate of the average annual rate of depreciation required for each of its classes of fixed capital." These estimates the commission reviews and certifies what it deems to be the proper rate. Such established allowances are to be employed in any subsequent proceedings involving the public utility's rates. A provision of unusual interest forbids the payment of dividends "except out of earnings remaining after crediting its depreciation reserve in accordance with rates established by the commission," except where the commission finds that such a requirement would be contrary to the public interest. With this provision should be compared the provision in a new statute governing the issuance of securities which authorizes the commission,

after investigation, to prevent any public utility from paying dividends when its capital is impaired. Such impairment may conceivably result where the depreciation reserve is found to be clearly inadequate. These statutes have not yet been put into effect by the commission, and therefore neither their practicability nor constitutionality has been tested.

A provision giving the commission discretionary power, by general order, to veto proposed construction activities is another new departure in the law. An order directed to electric and gas utilities has been promulgated by the commission, and one respecting telephone utilities is now being held under advisement.

Financing regulation—new style

The 1931 session of the Legislature provided for a new method of financing the commission. Heretofore the commission's requirements have been met out of the general funds by means of a flat appropriation. That portion of the appropriation available for public utility regulation (as distinguished from the commission's Blue Sky and other powers) has not increased, although the volume of the work has considerably increased. This has resulted in an overburdening of an undermanned staff and an inability to conduct comprehensive and thorough-going investigations.

A new policy was laid down by the 1931 Legislature in a statute imposing the cost of regulation upon the utilities, with a residual appropriation from the general funds for costs not properly chargeable to the utilities. The statute provides that the costs of the commission's special investigations shall be charged against the particular utility involved, and that the general residual costs shall be assessed annually against all the utilities in the state on the basis of their gross revenues. The statute was successfully challenged in the Circuit Court by the Wisconsin Telephone Company, the subject of a statewide rate inquiry instituted upon the commission's own motion. The Supreme Court of the state, on January 12, reversed the Circuit Court and sustained the statute in all respects. Further appeal to the United States Supreme Court may follow. None of the other companies against which charges have been made, including a large electric company, have challenged the law. These payments to the state are, of course, chargeable to operating expenses.

An important factor in the administration of public utility laws by a commission turns neither upon statutes nor upon expert personnel. I refer to the attitude which the commission takes toward its obligations.

Two points of view are possible and may be commonly found. One is the attitude that the commission is essentially a judicial body. Therefore, it regards its functions as primarily that of receiving complaints from interested consumers or utilities, receiving and considering testimony submitted by the parties and passing judgment upon the basis of that record. The second attitude is that the commission is primarily and in most of its activities an administrative tribunal. Therefore, it commonly enters into investigations upon its own motion and exercises a general supervisory control. A commission adopting this attitude will often, upon receiving a complaint and finding that it has merit, proceed then upon its own motion and direct its staff to submit testimony on the issues in the case.

The present members of the Wisconsin Public Service Commission are definitely committed to a predominately administrative conception of their obligations. There are, of course, exceptions to this principle. These relate particularly to those instances in which the commission is exercising a genuinely judicial function such as is involved where a municipality seeks to acquire a private utility and the commission is obliged to fix the compensation, where two private utilities are contesting for the right to operate in a particular territory and the commission must determine the issues between them, reparation proceedings, and the like. But in the general run of its customary duties to see that adequate service at reasonable rates is furnished, the commission has taken the position that its staff should actively prepare and participate in the proceedings. In some instances the need of such staff participation is occasioned by the fact that the application is *ex parte;* such a case is the application for the issuance of securities where the interest of investors and consumers may be affected. A more typical situation arises where a utility seeks to increase its rates, or consumers of a municipality complain against existing rates and seek reductions. In such cases the commission has concluded that, generally speaking, the consumers have not been adequately represented, and that it is a definite part of the commission's obligation to see to it that a complete and thorough record is made before it. The commission in instituting an investigation and insisting that an adequate record be made is acting as an administrator and perhaps in some cases as an inquisitor. Once the record is made, however, the decision must be made upon the facts in the record and without giving any weight to the fact that the commission itself directed that the record be made.

I have been asked to set out in this statment what the attitude of the electric utilities in the state has been respecting the new régime. What their representatives may be thinking, of course, I have no way of knowing. But their conduct to date has been almost without exception co-operative and helpful. Frequent informal conferences are held with responsible executives, in which frankness prevails. Business problems are discussed with the utmost candor on both sides, resulting in a better understanding by the commission of the trials of management and, we believe, in a better comprehension on the part of utility representatives of the duties owing to the public.

▼

Safety from Cave-in Hazards in Underground Construction

To avoid cave-ins and endangering of workmen in them, all excavations of the Milwaukee Electric Railway & Light Company in sandy or loose-filled material are sheeted tightly and braced securely as fast as they are dug. All trenches, even in the hardest of clay, are braced every 8 ft. as soon as they reach 4½ ft. in depth. Trenches within 2 ft. of a previous trench, building wall, curb line or a railway track zone are cross-braced every 8 ft. as soon as they reach 2 ft. in depth. Additional braces are added as the excavations are deepened. All tunnels over 8 ft. long are completely lined with strong sheeting. These practices were reported in a paper by R. L. Dodd before the Engineering Section, Great Lakes Division, N.E.L.A.

Cable Service Uninterrupted Though Channel Is Dredged

By A. W. MILLIKEN
Superintendent of Electrical Department
New Bedford Gas & Edison Light Company,
New Bedford, Mass.

When the United States government began to dredge the Acushnet River in New Bedford, Mass., the New Bedford Gas & Edison Light Company of the Associated System was faced with the necessity of moving its four cables and at the same time maintaining service supplied by these cables to an area of about 600 square miles, including virtually all of Cape Cod.

The river is about one mile wide at the point where the cables are laid. The cables, carrying 22,000 volts, stretch from New Bedford to Palmer's Island in the middle of the river and thence to Fairhaven on the opposite shore. All four cables were laid in unfilled trenches 5 ft. deep.

The government proposed to make the 25-ft. channel 5 ft. deeper and to increase its width from 300 ft. to 350 ft. In order to permit the dredging company to operate a safe distance from the cables, it was necessary to move them to a temporary position, 200 ft. upstream, and then, after dredging, back to their permanent location in a trench 5 ft. deeper than the new channel.

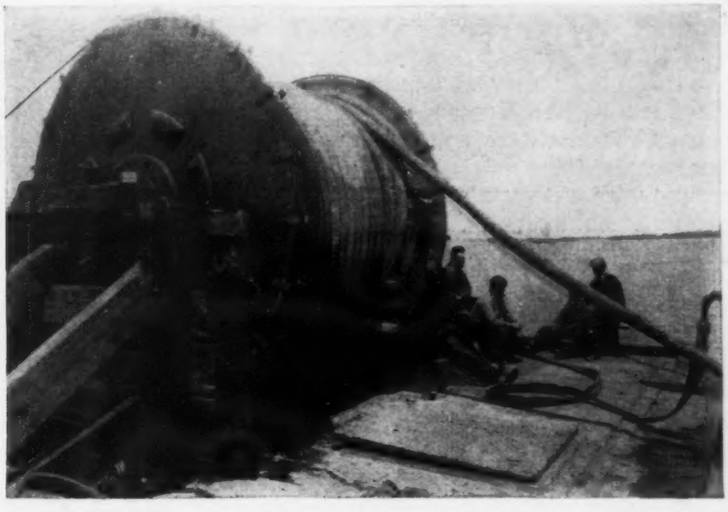
After considering several methods, including floating the cables on buoys and moving them under water by means of large steel reels, it was finally decided to break the joints at Palmer's Island, wind the cables on a large wooden reel fixed on a lighter, move them to their temporary location, unreel them and make up joints to maintain service. After the permanent trench was finished this operation was repeated, thus requiring reeling and unreeling each cable twice.

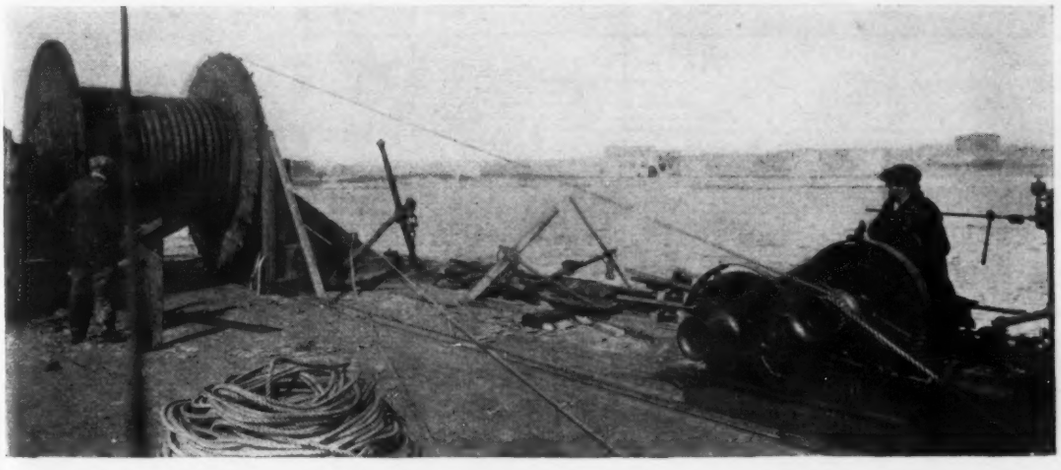
Two of the cables had been laid in 1915, one in 1924 and the remaining one in 1930, all being three-conductor, 22-kw. cables covered with cambric or paper and lead and armor.

The first cable picked up was the 1930 cable of 500,000-circ.mil conductor and paper insulation, weighing 21.8 lb. per foot. This cable came up easily with drive applied to only one side of the reel. About 1,500 ft. of this cable was taken up and relaid in one day. It was necessary, of course, to break the splice on Palmer's Island, and this had to be remade. No splice existed in this particular cable in the water. For the remaining cables, which were naturally more deeply embedded, a double drive on the reel was found to be necessary.

The next cable taken up was the one laid in 1924, a

Barnacles, mud and shells were cleared from cable as it was reeled





Cable reel supports and peripheral rope drive on reel

Note the joint which was reeled, unharmed, along with the cable.

Winch-driven reel for lifting cable

Note the single rope drive used here. This is the 1930 cable; earlier ones required a double drive.

three-conductor 300,000-circ.mil cable with round conductors, impregnated paper insulation, weighing 21.75 lb. per foot. It had two splices in the water, one west of the channel and one east. It was thought at first that it would be necessary to remake both of these splices, but it was found possible to handle the splices satisfactorily on the reel, thereby saving considerable time in moving to the temporary location. When finally laid in their permanent position all splices on all cables were remade in order to guard against any possible damage to the splices in moving.

The two 1915 cables were relaid in their temporary locations without reconnection, as it was possible to maintain adequate service with the two cables first moved. In removal to their original positions the 1915 cables were moved first and reconnected.

From the time when the reel was fixed on the lighter until the date when the last cable was put back into service was only two months. All the work was done with the original cable, no extra lengths being necessary. Service was maintained with at least two cables at all times, there were no accidents, and the entire job was considered to have been highly successful.

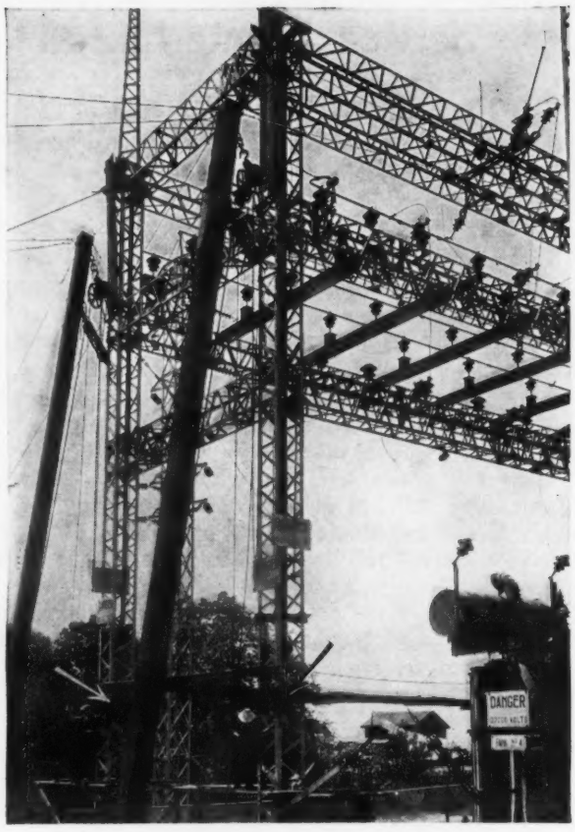
▼

Substation Structure Lowered by Shortening Supporting Towers

Dunwoodie Avenue substation of the Yonkers Electric Light & Power Company is at present supplied by means of two 132-kv. underground cable lines from the Hell Gate station of the United Electric Light & Power Company. Recently this substation has been partly rearranged to accommodate two 132-kv. overhead lines. A ground-wire network over the high-voltage section will form a continuation of the line ground wires.

In the rearrangement of equipment, buses and connections it was found practicable to lower the structures 12½ ft. and still maintain consistent spacing of conducting parts. This was particularly desirable as this amount of saving in the height of the towers supporting the ground-wire network was thus made possible.

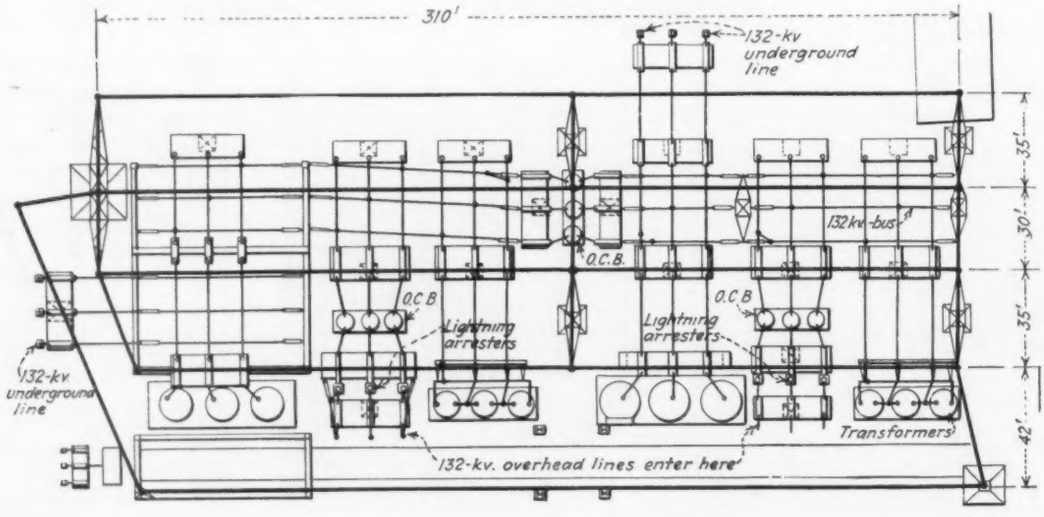
Lowering the structures was effected in two ways:



12 ft. of height saved by lowering structure

New bases attached, posts cut off and structure lowered.

The height of the 132-kv. section was reduced by cutting off the towers at the top; that of the 45-kv. section by a similar operation at the bottom. The work on the latter was started by attaching new bases 12½ ft. above the foundations at each tower. Timber masts were then erected at each tower to support the structure while the lower portion was cut away and during the lowering operation. The work was done with the bus de-energized and without disturbing the suspended equipment. The load on each corner mast was about 7½ tons while carrying the weight of the structure, 60 ft. long, 21 ft. wide and 70 ft. high.

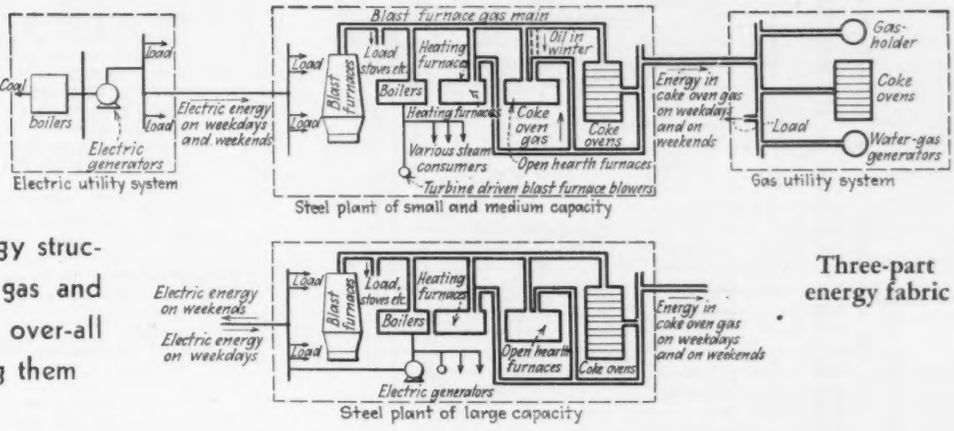


132-kv. station protected by grounded mesh

The ground wires will clear the 161-kv. opened disconnect switches on the 132-kv. bus by 21 ft. Line ground wires will tie into the network at the corners on the entering side.

Utility Ties Valuable to Steel Plants

By A. H. DYCKERHOFF
Chicago, Ill.



Triangular integration of energy structures of steel plant and of gas and electricity systems results in over-all economy distributed among them

Three-part energy fabric

HAVING discussed the price and cost of energy in the electric and gas utility systems and the energy structure of a typical steel plant, including the valuation of its by-product energy in previous articles,* this article concerns itself with the possibilities of energy exchange between any two and all three of the systems. Many of the considerations that enter the various possible combinations are quite obvious and can be passed over rapidly, while more detailed attention will be given to the energy integration in which all three systems appear. For instance, the blending of the energy structures of electric and gas utilities would consist mainly of the use of gas by the electric system in steam boilers, gas engines or gas turbines. It might also exist in a combination using some method of low temperature coal carbonization. But most of these possibilities lack economy at present under practically all conditions. In present-day practice energy exchange between electric and gas systems can hardly be more than special, as when in some regions large availability and consequent low price make natural gas an economical fuel for power stations or when, more commonly, gas supply for any reason exceeds holder capacity on week-ends or when supply and demand of natural gas must be balanced.

Coupling up the energy structures of two or several steel mills can cover blast-furnace and coke gas mains as well as the electric system. No doubt a better equalization of the gas conditions is attained and, thereby, a reduction of gas losses. However, coupling up the electric network of the steel plants shows but a moderate advantage, because the maximum demands of the electric load occur generally at the same time. The diversity factor is therefore not very favorable, it being about 0.965. Since, also, the valuation of the energy in the several steel plants and the cost of generating electric power are about equal, the total gain obtained by the mutual energy delivery between steel plants is limited.

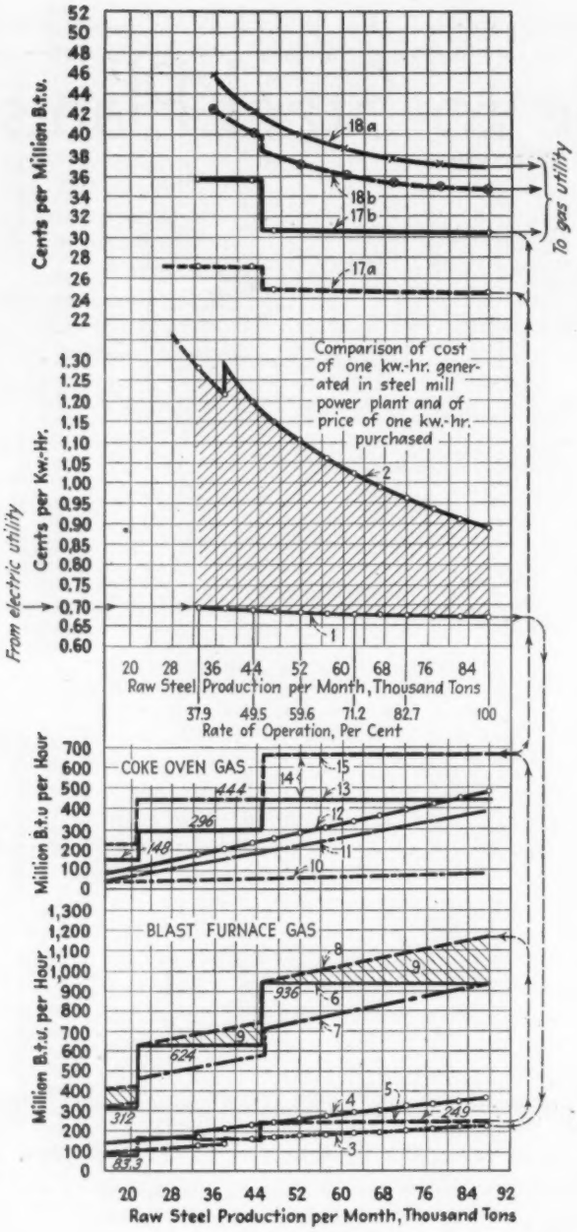
The coupling-up of these systems can be accomplished in the main by two methods: The first method embraces the delivery of coke-oven and blast-furnace gas by the steel plant to the boilers of the electric utility simultaneously with the coupling up of the electric systems of both. Delivery of coke-oven gas to the boilers of the utility can take place only if no other means of application can be found. Since the value of the blast-furnace gas within the steel plant, including cost of cleaning, varies between 19.3 and 20.5 cents per 1,000,000 B.t.u., and since it has a value of approximately 20 cents only to the utility power plant, its delivery cannot bring a gain, particularly since no cost of transmission has been allowed in these figures. Therefore, the delivery of blast-furnace gas by a steel plant can be considered only if the power plant of the utility and the steel plant are adjacent and, also, if there is a surplus of blast-furnace gas, having no value or a smaller value than about 20 cents per 1,000,000 B.t.u. within the steel plant, conditions met with in very few basic steel plants and only in plants having blast furnaces.

The second method concerns the connecting up of the electric systems of the utility and the steel plant. The electric utility could absorb possibly such surplus electric power as is generated by the occasional surplus of gas of the steel plant. If we assume that an energy of 13,900 B.t.u. be required to generate 1 kw.-hr. by large generating units, operating at 40 to 41 per cent capacity factor, the value of the fuel component of the cost per kilowatt-hour is but 0.238 cent at the central station. Now if the connecting up of the two systems is to serve the sole purpose of absorbing occasional and week-end surplus electric energy of the steel plant and transmission

Table I—Steel Plant Control of Gas Flow

Rate of Operation of Steel Plant (Per Cent)	Feasible Degree of Controlling Flow of Coke-Oven Gas Delivery (Per Cent)
30	77.2
40	66.4
60	64.3
70	55.9
80	48.7
90	40.5
100	32.3

**See articles on "Regional Energy Co-ordination Embraces Steel, Gas, Power Industries" and "Steel Plants Have Regional Energy Potentialities," page 406 and 449 in "Electrical World" for February 27, 1932, and March 5, 1932 respectively.*



The blended energy complex

1. Price of 1 kw.-hr. purchased.
2. Cost of 1 kw.-hr. generated in steel mill power plant.
3. Energy in blast furnace gas liberated by purchasing electric power in steel plant with small energy requirements.
4. Same as (3) but for steel plant with large energy requirements.
5. Energy in blast furnace gas required for underfiring coke ovens.
6. Energy in total blast furnace gas available.
7. Energy required for stoves, blast furnace and bessemer blowers, heating and open-hearth furnaces, various steam uses and losses.
8. Total energy required in blast furnace gas.
9. Additional energy required in blast furnace gas.
10. Energy in coke oven gas to heating furnaces.
11. Energy in coke oven gas to open-hearth furnaces in summer, in part replaced by oil in winter.
12. Energy in coke oven gas to open-hearth furnaces and heating furnaces.
13. Energy in coke oven gas available by underfiring with coke oven gas.
14. Energy in coke oven gas liberated by underfiring with blast furnace gas.
15. Total coke oven gas.

17a. Cost of coke oven gas liberated by blast furnace gas underfiring made available by purchase of electric power.

17b. Cost of coke oven gas liberated by blast furnace gas underfiring made available by purchase of electric power plus profit equivalent to return of investment within four years.

18a. Value of coke oven gas (available by coke oven gas underfiring) for open-hearth furnaces, including an increment of 15 per cent (assumed).

18b. Average value and cost of straight coke oven gas (Curve 18a) and of coke oven gas liberated by blast furnace gas underfiring (Curve 17b) with consideration of volumes involved.

The shaded area between curves 1 and 2 indicates the saving per kilowatt-hour obtained by the purchase of electricity. The evidence shows that under average conditions the blast-furnace gas liberated by the purchase of electric power just about covers the energy required for underfiring the coke ovens.

facilities have to be installed, it is readily calculated that a connecting up of the systems for that sole purpose is entirely uneconomical, if the necessary allowance for fixed and operating expenses and for losses incurred is being made.

However, since the generating costs of this typical steel plant vary between 1.279 and 0.887 cent per kilowatt-hour, considering the entire range of plant operation, and since the price of 1 kw.-hr., purchased from the electric utility in Chicago, varies between 0.693 and 0.672 cent at the same load factor, it is indicated that the more energy in kilowatt-hours required by the steel mill is covered by purchase from the electric utility, the greater profit is being obtained by the steel plant. Provided, therefore, a satisfactory disposal of the blast furnace gas can be arranged, it is good economics, as evidenced by the simple comparison of cost and price of 1 kw.-hr. available in Chicago, that steel plants of small and medium capacity should purchase all electric energy required from the electric utility. Steel plants having very large production should correspondingly cover at least part of the electric energy required by them by purchasing from the electric utility. In these cases, involving fair-sized volumes of electric energy purchased, it is feasible that the electric utility absorbs occasionally, on week-days and on week-ends, electric energy generated from surplus blast-furnace gas, because the rate of the purchased electric energy includes the fixed and operating expenses incurred by the transmission.

Gas utility and steel plant system

This interconnection is shown diagrammatically on page 491. It can consist of a direct connection of the coke-oven gas main of the steel plant with the mains of the gas utility; indirectly, however, the blast furnace gas can share in the interconnection by underfiring the coke ovens and therewith by the liberation of coke-oven gas. The value of the coke-oven gas for open-hearth furnaces varies betwen 40 and 32.1 cents per 1,000,000 B.t.u. and the cost of the coke-oven gas liberated by blast-furnace gas underfiring fluctuates between 28.0 and 25.15 cents per 1,000,000 B.t.u. when the steel plant is generating its own electric power, and between 27.1 and 24.7 cents per 1,000,000 B.t.u. when purchasing electric power. When considering the known fact that the cost of gas from a large coke-oven plant is approximately 20 cents per 1,000 cu.ft., equivalent to 35.7 cents per 1,000,000 B.t.u. (at 560 B.t.u. per cubic foot) when being operated at about 100 per cent capacity factor, it is readily recognized that true economies require that the flow of energy in the coke-oven gas occurs from the steel plant system to the gas utility system, particularly of that part of coke-oven gas showing the greatest price and cost difference; i.e., of the coke-oven gas liberated by blast-furnace gas

underfiring made available by the purchasing of electric power.

On the bases of energy price and cost, it has been proved that a steel plant, for greatest energy economy, should purchase all, or a large part, of its electric power requirements and should sell coke-oven gas. By purchase of the electric energy blast-furnace gas is liberated for underfiring the coke ovens, thereby making the lowest-priced gas indirectly available for sale to the gas utility system. On this basis, the blending of the energy structure of the utility systems with that of the typical steel plant for its entire range of operation has been carried out numerically and diagrammatically in the graph of energy complex, which is self-explanatory with the legend given and flow-lines marked. Briefly, the blending of the energy structures in this figure shows the following:

1. The great saving which can be obtained by the purchase of electric power is shown by difference (shaded area) of curve 1, representing the price of 1 kw.-hr. purchased, and curve 2, giving cost of 1 kw.-hr. generated in steel plant.

2. The energy (line 3) liberated by the purchase of the electric power for the typical steel plant with *small requirements for electric power* is slightly less than the energy consumed when underfiring the coke ovens with blast furnace gas (line 5).

For a steel plant with a large demand for electric power the amount of energy in the blast furnace gas liberated by the purchase of electric power is represented by line 4, which amount is slightly larger than that consumed for underfiring the ovens. *Therefore, under average conditions, the blast-furnace gas liberated by the purchase of the electric power covers about the energy required for underfiring the ovens.*

3. The application of blast-furnace gas in heating and open-hearth furnaces and for underfiring the ovens prevents the bleeding of blast-furnace gas, which conditions create a slight deficit of this gas (= difference between lines 6 and 8).

4. The coke-oven gas volume, enlarged by blast-furnace gas underfiring, permits a better blending into the structure of the gas utility. Its system labors under a very variable load, demanding large volumes during the heating season. The coke-oven gas available for sale under such conditions outlined above (difference between 15 and 10) for the typical steel plant in its entire range of operation is regulatable by the steel plant as indicated in Table I.

However, since no steel plant operates at a rate of 100 per cent continuously, and since the average rate of operation of the steel industry from 1922 to 1928 has been about 77 per cent, one is justified in taking a plant condition permitting a regulation of the flow of coke-oven gas of about 60 per cent. The control of the flow of gas to the utility can be accomplished by several means: One method provides for the use of oil and blast-furnace gas in the open-hearth furnaces during the cold season, when the largest volume of coke-oven gas would be delivered to the utility, reverting to the use of mixture of coke-oven and blast-furnace gas in summer. The other method would apply to the temporary underfiring with coke-oven gas in place of blast-furnace gas during the summer months.

5. The approximate minimum prices of the two volumes of coke-oven gas are given in the lines 17b and 18a.

The cost of the coke-oven gas made available by blast-furnace gas underfiring liberated by the purchase of electric power is shown in line 17a, which cost includes fixed charges of 15 per cent on the investment required to liberate that gas. Since frequently such a net profit is expected so as to insure the return of the investment within a period of four years, an additional charge has been set up and added to the cost, the sum of which is represented by line 17b. The other volume of coke-oven gas, produced by coke-oven gas underfiring, has likewise received an adjustment. Here 15 per cent has been added to its intrinsic value within the steel plant for open-hearth furnaces, of which 5 per cent serves to cover any additional energy requirements due to changing the fuel for winter and summer season and 10 per

The "super-power" station in the "super-energy" frame

This plant (State Line) of the Chicago District Electric Generating Company now contains one 200,000-kw. unit. It is an excellent example of the high economy station presumed in these articles. This station from time to time uses gas for fuel when excesses of supply require such use for balancing gas load.

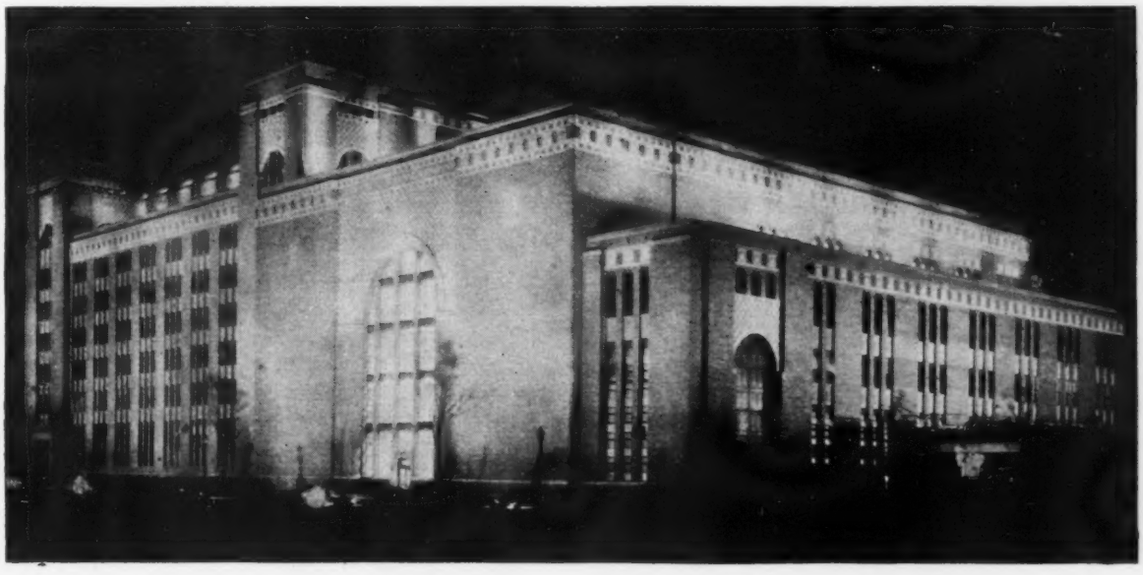


Table II—Steel Plant Power and Related Costs When Coupled with Utility Systems

Production, Tons Raw Steel	Kw.-Hr. Required per Month	Price of 1 Kw.-Hr. Purchased	Total Cost of Purchased Electric Power, (Dollars per Month)	Production Use Costs,* (Dollars per Month)	Net Profit on Sale of Coke Oven Gas (Dollars per Month)	Total Net Cost (Dollars per Month)	Total Net Profit Due to Co-operation with Utilities (Dollars per Month)	Dollars per Month per Ton of Raw Steel
33,100	4,983,000	0.693	34,500	126,650	3,030	158,120	44,880	1.36
38,000	5,323,000	0.691	36,700	136,000	6,860	165,840	46,160	1.21
43,200	5,693,000	0.688	39,100	145,600	10,100	174,600	48,400	1.12
47,200	5,958,000	0.686	40,800	162,500	16,150	187,150	48,850	1.03
52,100	6,278,000	0.684	43,000	171,700	17,150	197,150	47,450	0.91
57,200	6,623,000	0.682	45,000	181,000	18,020	207,980	46,020	0.80
62,200	6,938,000	0.68	47,100	190,000	18,580	218,520	44,480	0.71
67,200	7,278,000	0.678	49,400	199,500	19,100	229,800	43,200	0.64
72,200	7,558,000	0.677	51,100	208,000	19,500	239,600	42,400	0.59
77,300	7,848,000	0.675	53,000	218,800	19,900	251,900	39,100	0.50
82,200	8,223,000	0.674	55,500	228,000	20,050	264,450	37,550	0.45
87,300	8,553,000	0.672	57,400	238,000	20,250	275,150	*37,850	0.43

* Cost of blast furnace blowing, bessemer blowing, steam for miscellaneous uses, operation of heating furnaces and open-hearth furnaces.

cent has been assumed as a minimum net profit. By this means curve 18a was determined. To obtain a composite minimum price of these two volumes curve 18b was computed, based on line 17b and curve 18a and the actual volumes involved.

As stated previously, practically the same fundamental conditions apply to steel plants of very large capacity, which permit, likewise, a very close co-operation with the utilities. Here only a part of the electric energy required by the large steel plant and only a part of the total coke-oven gas produced would participate in the exchange of energy through purchase and sale. The blending of the energy structures would be still more close, inasmuch as week-end electric energy from surplus blast-furnace gas would frequently be absorbed by the utility, with a credit per kilowatt-hour equivalent to the approximate fuel value of the base-load central station.

Cost exhibit of typical steel plant coupled with electric and gas utility systems

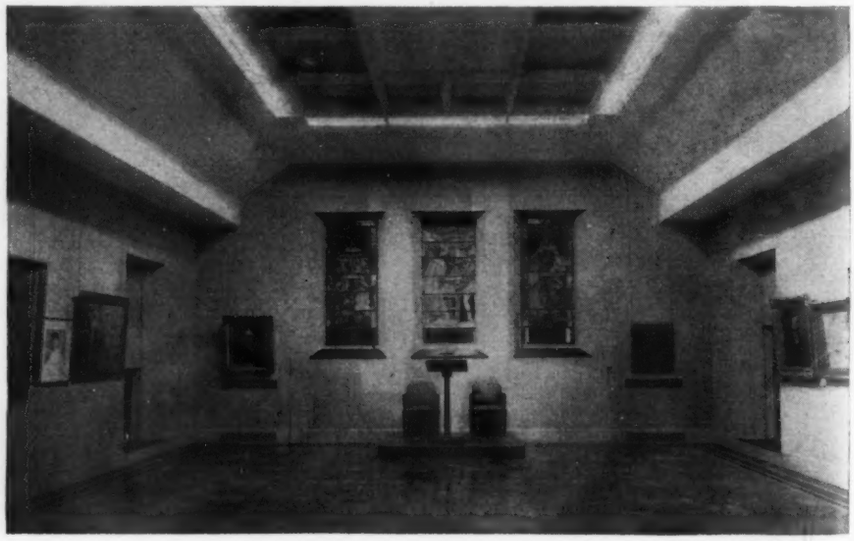
If one now takes the close blending of these three systems as a basis, as it is carried through in the energy complex, and computes the cost exhibit, drawn up analogous to that of the isolated energy system, of the typical steel plant very considerable saving will be obtained, as is evident from Table II. Since all electric power would be purchased, the main power plant would have but blowers and boilers. Soaking pits and heating furnaces would be heated with blast-furnace gas slightly enriched with coke-oven gas to 117 B.t.u. per cubic foot. The open-hearth furnaces would operate in part on a highly preheated mixture of blast-furnace and coke-oven gas (247 B.t.u. per cubic foot), in part on blast-furnace gas and oil, in order to obtain adjustment of the flow of coke-oven gas corresponding with a gas utility load factor of about 75 per cent. It has been assumed that the price received for the coke-oven gas liberated by blast-furnace gas underfiring would be equivalent to 32.2 cents per 1,000,000 B.t.u. and for the coke-oven gas produced with coke-oven gas underfiring equivalent to approximately 42 cents per 1,000,000 B.t.u. This has been done for the sake of simplicity, because the cost and value of the coke-oven gas vary with the production, as curves 17b and 18a show.

The total net profit, due to the close co-operation with the electric and gas utilities, would be between $37,550 and $48,850 per month and between $0.43 and $1.36 per ton of raw steel depending on the rate of operation. These very astounding figures speak for themselves. Some may argue about this or that figure, others may feel vexed about operating the steel plant as discussed, but the net profits obtainable are so large that a slight reduction cannot change the result materially, namely, that "super-energy" as applied to electric and gas utilities and basic steel plants affords true economy.

▼

Lighting a Small Art Gallery

Lens plates mounted flush with the ceiling and lamps of 60- and 100-watt rating are effectively used at the new Winchester, Mass., public library's combined art gallery and auditorium to provide 18 ft.-candles on the picture area of the walls and 5 ft.-candles at the floor level. The room is 33 ft. long x 29 ft. wide x 16 ft. high. In general the lamps are spaced 7 in. apart, with subdivided circuits to facilitate varying the intensities. In each corner an open 60-watt lamp is provided for general use, as in watchman's inspections. Proceeding from each corner in each direction along right-angled axes are four 100-watt lamps, or eight per corner, and in the middle sections looking toward the rostrum are sixteen 60-watt lamps on each side of the hall. At each end in the middle are eight more 60-watt lamps, or sixteen in all. This disposition gives a total of 64 60-watt lamps and 32 100-watt lamps for the complete installation, plus the four corner units mentioned. Kirbylite lenses are used. The absence of projecting fixtures has received much favorable comment.



Diffused lighting of exhibition room from overhead units frees display space from all obstructions

Frequency, Time and Load Control on Interconnected Systems

By PHILIP SPORN and V. M. MARQUIS
American Gas & Electric Company

Operation of any large interconnected system involves such questions as individual plant economy, tie-line loading, interconnected contractual agreements, frequency and time deviation. To overstress unduly any one of these points will invariably upset system operation. Experience along these lines is cited.

Frequency regulation at one point only, either manually or automatically, has not proved a practical solution of the problem, because all errors in the co-ordination of load demand and generating capacity on all parts of the system are reflected over tie lines to the frequency regulating station. Theoretical analysis and actual experience bear this out. Automatic frequency control (plus automatic tie-line control if necessary) at many points on an interconnected system gives promise of a satisfactory solution.

FREQUENCY, time and load control have caused a great deal of concern and considerable difficulty within the last few years, particularly on interconnected power systems. Unfortunately, the distinction between these three functions, closely related as they are, has too frequently not been entirely understood, with the result that emphasis has at times been placed on one aspect of the problem and action taken accordingly, whereas some other phase of the problem should logically have received major consideration. For example, consider the charts taken over the same two-hour period during an evening peak and shown in Figs. 1, 2, 3 and 4 respectively:

So far as frequency (Fig. 1) is concerned, it will be noted that there should be little chance of complaint from customers even with the appreciable rise of 0.15 cycle around 5:30 p.m. Between 4 and 5 p.m. the frequency is particularly good. It is conceivable that the frequency might have gone up as high as 60.3 cycles without appreciably affecting service to the entire group of power users on this large network. From examination of the time chart during this period (Fig. 2), it will be noted that the initial deviation was approximately two seconds from true Arlington time, but improved for a good portion of the period, coming frequently very close to true time. At [illegible] time was the deviation greater than the initial deviation. It is conceivable that the time deviation might have been ± ten seconds with very little, if any, complaint about the time service given by a synchronous electric clock.

On the other hand, if Fig. 3 is examined, it will be seen that the tie-line loading, starting in with almost zero at the beginning of the period, increased to 50,000 kw. at the end of twenty minutes, dropped down to zero again at the end of 45 minutes, built up to 100,000 kw. in another 45 minutes, then oscillated back and forth during the rest of the time. During the interval the tie-line was building up a load of around 100,000 kw.

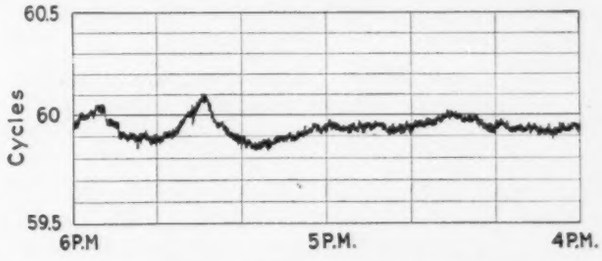


Fig. 1—Frequency during rapidly changing load period with limited capacity under automatic frequency control

Interconnected system involves about 3,500,000 kw. generating capacity (normal).

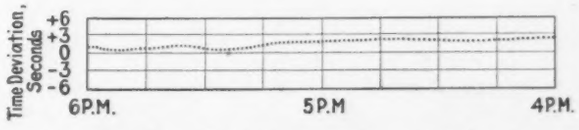


Fig. 2—Time deviation over period shown in Fig. 1

Represents departure of time shown by synchronous clock from Arlington time.

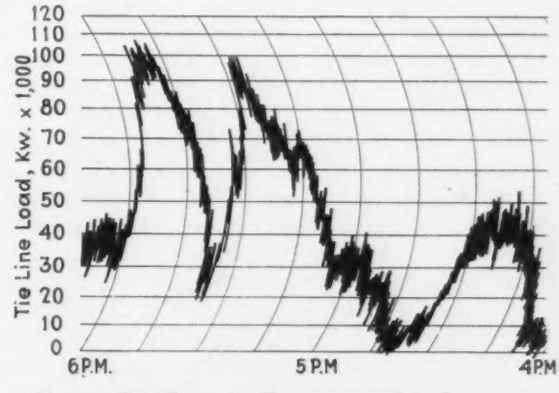


Fig. 3—Load on tie line connecting frequency regulating station with rest of system

Refers to same period as Fig. 1. The relation between tie-line loading and time deviation is shown by comparing Figs. 2 and 3.

the regulating plant was increasing its load (Fig. 4) from slightly over 60,000 kw. to almost 160,000 kw. In other words, the entire increase in tie-line loading came from a particular plant.

Here, then, is a real problem. If the normal function of the tie line is to deliver power proportionate to its capacity and to the load at its receiving terminal it is obvious that it was not performing with any particular relationship to those requirements. Nor was the steam plant doing so, if we consider its prime function

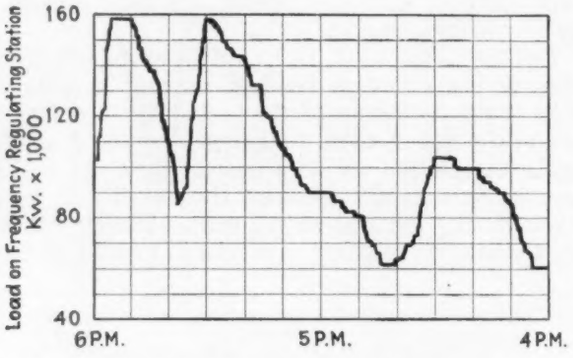


Fig. 4—Load on frequency regulating station during period represented by Figs. 1 to 3

This station is equipped with automatic frequency controller.

to generate a definite amount of power (depending upon the load) as economically and as safely as possible. In short, the normal functioning of both tie line and the plant were being interfered with to a great extent. The problem in this case, therefore, is not one of improving frequency or time control, but rather one of tie-line loading and plant operation. In this particular case both of these problems have been brought about by an attempt (a very necessary attempt as will be shown later) to regulate automatically frequency, and with it time.

In this and a succeeding article an attempt will be made to cover fully the four aspects of the problem, their relation to each other, the effectiveness of various methods of automatic control from all standpoints and the phases of the problem that still require solution.

Little improvement in frequency control until recorder was developed

Going back a decade, frequency regulation, as we think of it today, was substantially unknown. Neither the small nor the very large interconnected systems made any special attempt to regulate frequency. The instrument used as a criterion for frequency was the vibrating-reed type frequency meter, and considering the inherent error of the particular instrument, it is obvious that a frequency accuracy of plus or minus 1 cycle was substantially all that could be expected. In fact, until the advent of the modern type frequency graphic recorder the extent of the frequency variation was not realized. During a good portion of that time it is true that the industry went through periods when many systems had to contend with excessive shortages of capacity. Sometimes with inadequate generating facilities, the frequency was of necessity allowed to drop 2 or 3 cycles in attempting to hold load. In such events an attempt was always made to bring the frequency back somewhere near normal and, generally, this attempt met with success within a reasonable period. Then, too, in the early days interconnected systems were not as numerous and far less extensive than they are today and the poor frequency regulation had very little effect, except in so far as it affected the speed of motors. Even the development of equipment giving a visual indication of the cumulative deviation in average frequency did very little to improve results in many cases until the frequency recorder previously mentioned was made available.

Prior to the advent of the master clock and frequency recorder, systems had begun to interconnect throughout the Middle West, and with this interconnection came difficulties with tie-line loadings, particularly the inability to make tie lines operate in accordance with contractual agreements. For example, lines that were intended to deliver power were actually back-feeding into the supply area. It was felt initially that frequency regulation, or lack of it, had something to do with the problem and an investigation of the governor problem followed. While this yielded some improvement, it was not until an actual record was obtained that definitely showed the extent of the frequency variations that any real progress was made toward improving frequency. In Fig. 5 is shown a frequency chart taken with one of the first graphic frequency recorders of the modern type. It will be noted that in a period of twelve hours the frequency shows a variation from below 59.5 cycles to over 60.3 cycles, with several major swings lasting three and four hours. With a more accurate measuring stick available frequency was naturally watched more closely, but each plant on the interconnected system continued to do substantially its share of frequency regulation. This produced a more satisfactory result than had been available theretofore and the frequency was substantially constant, and certainly a great improvement over what had existed prior to the graphic recorders. Fig. 6a is typical of the frequency existing at about that time under the multiple method of hand regulation of frequency. But after this initial improvement in operation, that came with the advent of the modern frequency

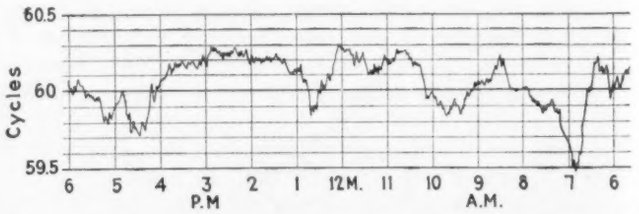


Fig. 5—Frequency recorded by one of first graphic meters installed on interconnected system (1925)

recorder, progress became rather slow during the next three or four years.

As pointed out, the multiple method of hand regulation was fairly satisfactory and gave smoother operating results on the various tie lines extending over hundreds of miles, but the difficulties that developed or still remained led to its abandonment early in 1929. The troubles, in brief, were:

(a) Frequent sudden fluctuations in frequency due to realization on the part of one or the other of the chief operators on the various major systems that frequency was getting ahead or behind of normal, or that his system was picking up or losing too much load and immediately attempting to correct it.

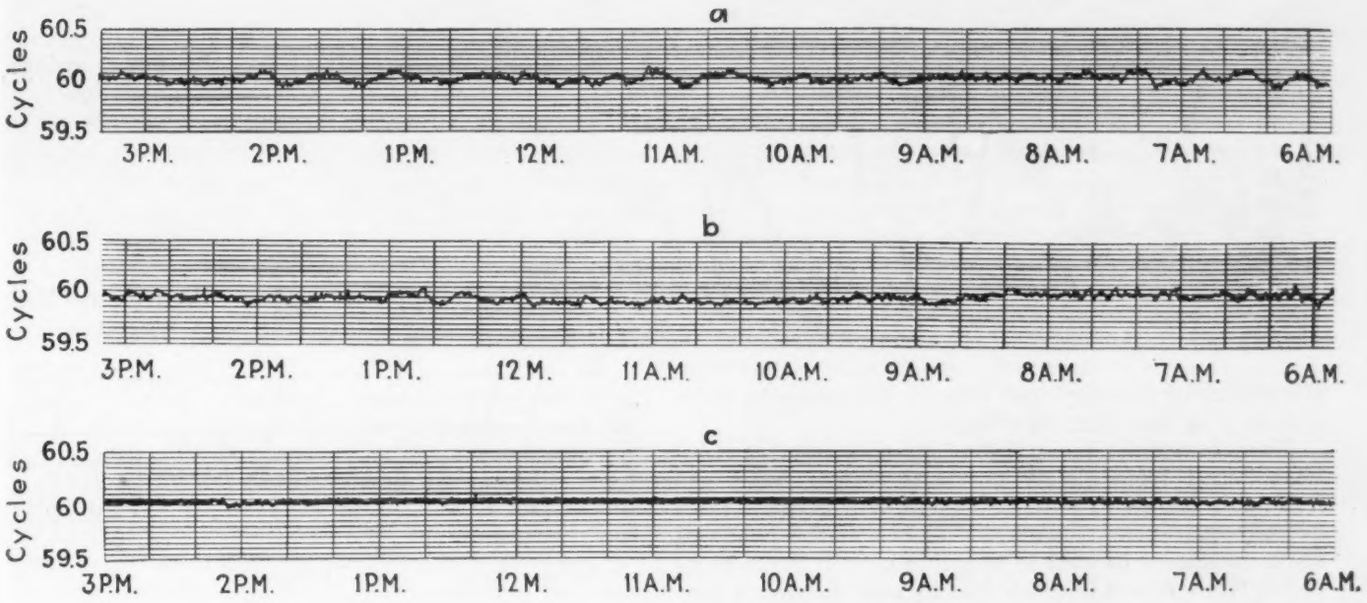


Fig. 6a, b, c—Frequency records obtained with different methods of control

(a) Multiple method of hand control; (b) hand control at a single station; (c) automatic control at single station.

(b) An aggravation of the difficulty outlined due to inaccuracy of frequency recorders. This frequently brought about a condition where a frequency recorder which indicated high in one part of the system led to action toward reduction of generated power when at the same time a frequency recorder on another portion of the system which indicated low led to action toward increasing the generated power. This consequently resolved itself into a tug of war between two generating systems, one doing its utmost to decrease speed of the system and the other to increase it.

(c) The overzealous attitude of some station operators toward holding up their particular station load in order to make a good showing on generating economy.

After many discussions on the subject it was decided that the simplest way out of the difficulty would be to allocate frequency regulation to one station on the system. It was believed that this would eliminate the difficulties brought about by inaccuracies of frequency recorders and that with an accepted frequency line that it would be relatively simple for other companies to maintain schedules on tie lines. Because of its joint ownership and its central location, the Windsor station* was selected for this trial and novel method of frequency regulation for an extensive interconnected system. The results shown by Fig. 6b give an indication of how well this method worked out in so far as the steadiness of the frequency line was concerned.

In order to clarify some of the subsequent discussions, it might be well to point out that this method of operation consisted of Windsor regulating frequency, with the outlying plants regulating the tie-line load. With this set-up, the frequency-regulating plant was made the final judge as to frequency and all other plants on the system agreed to make no attempt to actuate governors for frequency purposes as long as Windsor held frequency within reasonable limits. The test initially was intended to be carried on for a few days only, but it was found that this method of operation with a single plant regulating the frequency so greatly improved interconnected system operation that that method of operation was continued.

But here again it must be pointed out that the object and actuating motive for frequency regulation was not time or frequency itself, but improved system operation and tie-line loading.

This method of operation, while it improved system operation and tie-line regulation, placed a very heavy burden upon the load dispatchers of the regulating plant, since they at all times had to watch the frequency line and regulate their generators accordingly. Then, too, this method had the usual disadvantages of hand regulation in that a change had to be definitely brought about and recorded before any steps could be taken to improve the condition. To get away from these difficulties it was decided to install an automatic frequency controller to replace hand regulation. The results from a frequency regulation standpoint of this method of operation were such as would have been totally disbelieved only a few years ago; in fact, they were practically close to perfection. Fig. 6c is typical of the frequency on this system under this method of operation. It will be noticed that it is only seldom that the maximum variation in frequency is plus or minus 0.05 cycle; the average variation is well under that, and is much more of the order of plus or minus 0.03 cycle.

During the period when interconnection was leading to tie-line troubles, and, in turn, to efforts to improve frequency there were two other factors that added incentive to the holding of closer frequency. These were (1) the constant additions to central electric supply systems of loads which formerly depended on their own or on special equipment for frequency and speed regulation; (2) the application of the synchronous electric clock. In connection with the former it must also be borne in mind that the standards of frequency regulation had been consistently raised by the supply companies themselves, which again had the effect of bringing a demand for still closer regulation. The development of the synchronous electric clock had a considerable bearing on

*The development work at Windsor and other places cited was carried out jointly with the close co-operation of the staffs of the West Penn Power Company and of the Ohio Power Company, which jointly own the Windsor station.

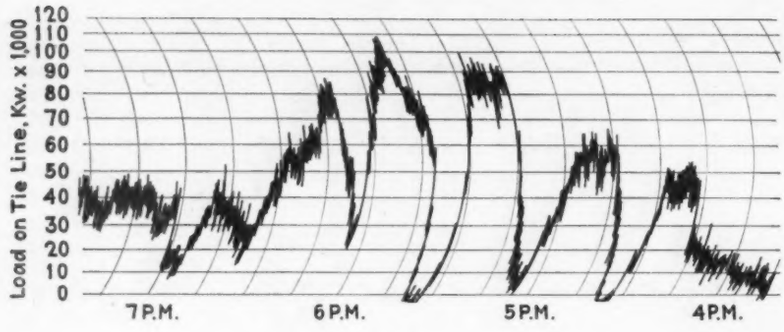
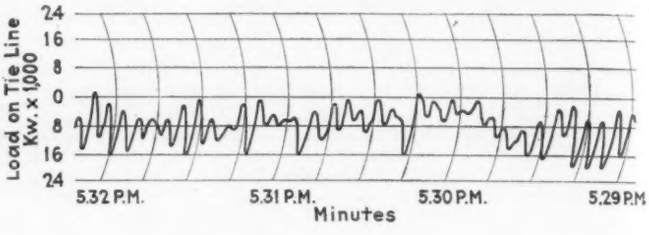


Fig. 7—Example of excessive power swings on tie line connecting regulation station to interconnected system

Fig. 8—Inherent power swings on tie line connecting two large systems



the matter of holding close average frequency in order definitely to limit time deviation.

Many companies realized the time accuracy that could be obtained from closely regulated system speed and made this known to their customers, and in some cases actually guaranteed time service. It was the policy of some companies to hold time within certain limits at all times, while others allowed time to vary somewhat during the day and took advantage of the light-load period at night to correct time error. Again, there were cases where two companies operated in parallel, one selling time service and the other not doing so, and therefore not interested in keeping average frequency within very close limits. In such cases it was customary to go out of parallel at night and allow the one company to correct its time. In certain cases this resulted in a tendency to overstress the time question and at the same time to overlook the relation of time to system operation. This striving on the part of some interconnected companies to maintain high time accuracy resulted in operating difficulties and especially excessive load transfer across tie-lines.

In so far as time is concerned it is our belief that in the final solution of this question of interconnected system operation the ability to furnish time service of extremely high accuracy will be obtained as a natural byproduct.

While the one centralized regulating point for frequency gave almost perfect results so far as frequency is concerned its very perfection proved to be its most vital weakness and brought about the developments that are displacing it today as a practical method of maintaining frequency on a large interconnected system. For, after all, what makes frequency regulation possible? Obviously it is not a master clock nor is it an automatic frequency controller nor the combination of them. The fundamental thing necessary for frequency regulation on a system is a proper balance between load and generating capacity available on the system to supply that load, and in a practical system where loads may come on very suddenly or drop off just as suddenly, or where the output of a certain station may be lost by virtue of the disability of one or more units, this means a certain amount of spinning reserve or excess generating capacity turning over, which can be made available almost instantaneously when and if a condition arises that demands additional generator output in order to allow the system to continue to function at a constant speed or frequency.

It is apparent that having this flexible portion of the capacity, if we may term it such, concentrated all at one point makes it very convenient from a control standpoint, whether that control be manual or automatic. On the other hand, for a system of any material size, it may involve a considerable percentage of the entire generating capacity of the regulating station. Further, it is evident that if the tie-line connections between the station controlling frequency and that portion of the system which may demand the maximum amount of increase or decrease of generated capacity should be of limited capacity (as opposed to lines of infinite capacity) all these increases or decreases in plant loading, when being transferred across this line, will result in materially upsetting the normal loading of the tie line. The sudden variations in its loading may actually over-reach its capacity either from a thermal or from a synchronous standpoint. This shifting of tie-line loading beyond reasonable limits was exactly what happened.

The frequency regulation during substantially all the period when the regulation was done automatically by the one station got so close to perfection that some of the things which came as byproducts of this perfect regulation were in many portions of the system given a significance bordering on a fetish, although it did not make any material difference whether or not those particular byproduct functions were carried out within the perfect limits that were actually obtained. Such, for example, is the regulation of time, which in this case came as a true byproduct of system frequency regulation, but which after a while was sought for itself, although the results of such a search afforded very little material remuneration.

Examining Fig. 4, for example, it can be seen that any system of regulation that will increase the load of a station within a period of less than an hour by 100,000 kw., and then within a period of less than ten minutes will drop almost a similar amount of load, cannot be looked upon with equanimity by those whose duty it is to watch out for the proper and efficient operation of the station. Further, it is quite evident that such a method of regulation brings with it difficult problems of boiler room operation such as handling fires in boilers, steam pressures, etc., when loads of 80,000 or 100,000 kw. are dropped almost instantaneously. While such contingencies can be taken care of when they occur only

occasionally, they are far more troublesome when they occur hourly or more frequently than that. In Fig. 7 is shown an extreme though not uncommon case of tie-line load variation; only the exceptionally close attention given to boiler operation has made it possible for Windsor to follow these load changes. The magnitude, suddenness and duration of swings could not be forecast. It meant that at all times capacity had to be kept available, and this, of course, materially and adversely affected station economy.

Inherent power swings—power drift across tie-lines—time deviation

To get a proper insight as to the causes of the erratic swings on the frequency regulating station, it is necessary to consider in some detail the relation between system speed and tie-line loading. In the operation of any large interconnected system three characteristic phenomena are always in evidence. These are (1) inherent power swings, (2) power drift across tie lines, and (3) time drift resulting from frequency deviation.

By inherent power swings is meant the normal power swings that take place between any two generating and load sources connected through a transmission line of finite reactance. Fig. 8 shows the natural swing between two large interconnected systems. The magnitude and periodicity of this swing are dependent upon the stored energy of all rotating apparatus in the two areas and the reactance of the transmission line (and transformers if any) between the two areas.† It will be noted that this swing varies in magnitude from 2,000 kw. to 12,000 kw. and makes a complete cycle in about five seconds. Thus even a well-regulated tie line will show a band rather than a straight line. In the case just referred to it can be shown that this swing in kilowatts is accompanied by a slight change in speed which might amount to plus or minus 0.01 cycle, depending on tie-line load. It is obvious that neither hand control nor automatic control should attempt to correct for this swing.

Typical cases of power drift between systems are illustrated in Figs. 3 and 7. This power drift may come about in several ways, a few of which will be briefly commented upon:

(a) Consider two areas each having its own generating capacity and load and connected together by a tie line. If one area is short on reserve capacity and load comes on in excess of its generating capacity, there will be a tendency for the machines in the other area to pick up this load, with resulting increase in load across the tie line and an accompanying drop in speed. It is assumed that up to this point the speed regulation is being handled by the governors.‡ But if operators in the area having reserve capacity make an attempt to bring the speed back to normal, this power drift will be increased.

(b) Consider the same case except with adequate reserve capacity in each section. Also assume that operators are attempting to hold the frequency at normal. If additional load comes on in one area, and the operators in that area are slow in increasing generation to meet this load, some will be picked up by the other area and will show up as a power drift across the tie line; this will probably develop into two or three reversals of drift across the tie line once the operator in the first area finds that he is low on generating capacity and attempts to correct it. This all means lack of co-ordination of plant schedules in any given area.

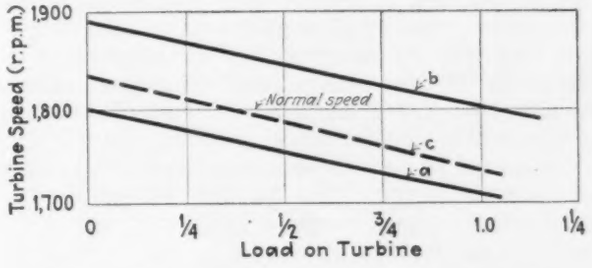


Fig. 9—Steam turbine governor characteristics

With governor adjusted to give normal speed (1,800 r.p.m.) at no load, speed will drop as shown by curve *a* if load is added. To give normal speed at full load, governor must be adjusted to give curve *b*. Per cent regulation is usually defined as per cent speed change over the no-load, full-load range. Terminal conditions must be stated. Curve *c* shows typical case where governor is adjusted to give normal speed at one-third load; if load is reduced to zero, speed rises 2 per cent; if increased to full load, speed drops 3.6 per cent or regulation is 5.6 per cent.

(c) Following this idea a little further, it is evident that in all probability there will be several reversals of power across tie lines during rapidly changing load periods due to the fact that the generation is never picked up at exactly the same rate as the load comes on, and all these errors in load pick-up mean load transfer across tie lines. This is true whether the machines are on governor control only or whether attempts are made to bring the speed back to normal by hand.

(d) Automatic frequency control at one point on the system therefore quite logically has a tendency to aggravate this condition of power drift over tie lines. Experience has shown that with frequency regulation at one point only, conditions are materially improved provided all interconnecting areas watch tie lines very closely. However, it seems reasonable to expect that even with close hand regulation on tie lines there is a tendency for this drift to creep in. This is partially explained by the fact that the automatic controller is more constant and consistent in its corrections than the hand-regulated stations and, further, that the hand-regulated stations cannot at all times watch tie lines only and obtain proper results. This will be gone into more thoroughly in connection with the consideration of automatic tie-line control.

Any drift in power between stations is accompanied by a change in frequency and, therefore, time deviation or time drift. It is of interest to study tie-line load and time deviation over any given period such as shown by Figs. 2 and 3. The principal benefit of a comparison of such charts over the same period is that it definitely ties down what was taking place during the period with reference to system loading, system speed and who was at fault. Consider, for example, the period between 4:45 and 5:25 p.m.; it will be noted that the output from the

†R. H. Park has shown that the natural frequency of such a system is

$$f = \frac{1}{2\pi}\sqrt{K\frac{M_1 + M_2}{M_1 \times M_2}}$$

where f = natural frequency in cycles per second, $K = 2\pi fo \frac{E_1 E_2}{x} \cos\phi$; fo = Normal system frequency; E_1, E_2 = Voltage at the two ends of the tie line; x = Tie-line reactance; ϕ = Displacement angle between voltages E_1 and E_2; M_1, M_2 = Inertia effects of the two systems.

This special case assumes voltage maintained at each terminal of the tie line. For the rigid solution it is necessary to include synchronous reactance of each equivalent machine and take E_1 and E_2 as the equivalent machine voltages behind synchronous reactance.

‡Any prime mover usually requires some regulating device to control speed under various load conditions. Since it is impossible to duplicate governor characteristices exactly, it is necessary to design the governors to have drooping speed-load characteristics in order that the load will be properly divided among the prime movers operating in parallel. Such a governor characteristic is shown in Fig. 9. Thus, on any system, however complicated, all prime movers, no matter how widely separated, will each take a portion of any load change regardless of where on the system the load change takes place.

In actual practice slightly temporary speed changes must of necessity occur with any change in load. The speed may be brought back to normal by operating the governor synchronizing motor, and it is obvious that this change may be made manually or automatically by some device sensitive to speed change.

regulating station over the tie line increased about 100,000 kw. and that during this time there was a time loss of aproximately three-quarters of a second. This at once ties down the fact that the areas connected to the other end of the tie line were at fault with respect to regulation. If, on the other hand, the regulating station had increased its output over the tie line as shown and the time had gained, then the regulating station would have been at fault because it would have been running above normal speed.

These factors all point toward a definite relation between system speed and transfer of power across tie lines. In a complicated interconnected system it is therefore necessary to have some standard toward which all are working, and a convenient standard has been found to be speed because it is absolutely impossible for one area to take care of its own load with the governor set for a certain speed and another area to take care of its own load with its governors set for some other speed. The entire interconnection must, of course, operate at the same speed, and laxity on the part of one area results in power transfer across tie lines. In this connection it should be pointed out that *average frequency* does not necessarily solve the problem, for in Fig. 1 the *average frequency* is excellent, but system operation was far from satisfactory.

Proposed solution of the problem is suggested

The problem thus logically resolves itself into one of allowing each area to take care of its own load and for the interconnection to offer mutual help in time of emergency or to allow certain definite amounts of power to flow over the tie lines in accordance with contractual relations between companies. Theory and the experience cited have demonstrated that speed regulation at one point only is not the final answer to this problem.

In attacking this problem on the interconnected system described, it was decided that some means must be obtained to make sure that the generators in each area were left free to operate on their governors, but in some definitely co-ordinated manner. Several methods for doing this were studied, such as tie-line control between all companies, with frequency control at one point; frequency control alone at many points, and frequency control at many points supplemented by tie-line control where required. The conclusion reached was that in the ultimate set-up some master control in addition to tie-line control will be required in each area. This inevitably gets down to frequency control.

Having determined this, it was obviously necessary to find out whether or not available or any type of frequency controllers would parallel. After investigating the two types available it was decided to try out parallel operation of both types of frequency controllers. In doing so it was realized that this step was not the final answer and that tie-line loading might be somewhat upset, but it was felt that this would not reach the extent that it would with one point of control only. Thus it was not expected that automatic frequency controllers on two ends of a tie line would necessarily maintain any given contractual power transfer across the line.

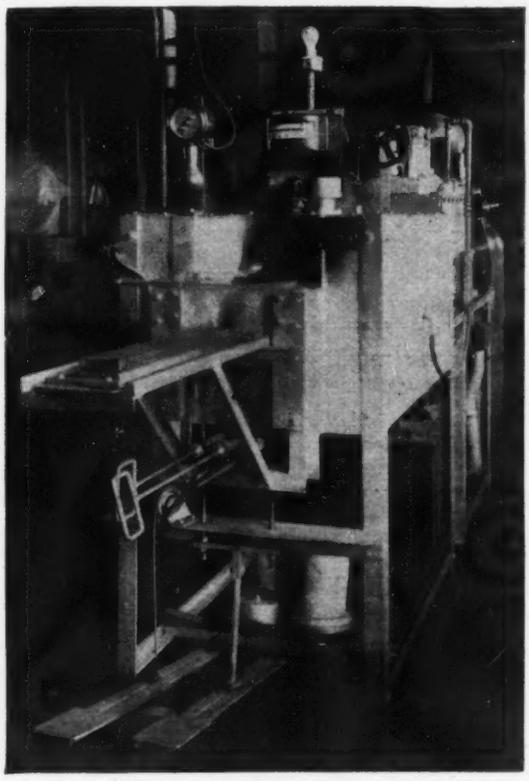
Actual experience with multiple controllers, including an analysis of the underlying principles, and of the place of tie-line control in system operation will be given in a subsequent article.

Electric Plating Furnace Speeds Operations

By SAMUEL D. FITZSIMMONS
Narragansett Electric Company, Providence, R. I.

An unusual type of electric furnace has been put in operation at the Providence plant of the Improved Seamless Wire Company, manufacturer of rolled-gold plate material, to solder a thin plate of gold to a thicker plate of base metal, although annealing of small parts is also done to advantage.

The essential elements are a furnace, a press and a cooling chamber. These are so arranged that the two metals, laid one above the other with a very thin sheet of solder between them, may be inserted in the furnace at one end of the unit and then moved, at the required temperature and without coming into contact with the atmosphere, from the furnace to the press and thence to the cooling chamber at the other end of the unit. This eliminates the use of from three to five heavy clamps, with the attendant additional metal to be heated and cooled.



Combination of furnace press and cooling chamber

The 8x24x3-in. furnace chamber is brought to its operating temperature of 1,425 to 1,600 deg. F. with a 7½-kw. unit operating on 220-volt, single-phase, 60-cycle current. It is equipped with a pyrometer for accurate temperature control and two pilot lights, a red one showing when the current is on and a white one connected into the time-clock circuit, so that when this light goes out, after about 25 minutes, the operator is reminded

that the stock is ready to be removed from the furnace chamber. He depresses a foot pedal, which raises an insulated door between the furnace and the press chambers, and then inserts a rod of predetermined length through a small hole in the furnace door and pushes the stock through to its correct position in the press. From a convenient push-button station the attendant controls the ¾-hp. motor which operates the press to provide a total pressure of about 5 tons, or approximately 70 lb. per square inch. When the press is released the material is pushed into the cooling chamber, where the temperature is reduced with circulating water piped around the chamber.

During the entire process hydrogen gas is allowed to flow into all three chambers so that oxygen is prevented from seeping in around the doors at either end of the unit. As a result the material is delivered from the cooling chamber clean and bright. Aside from the improved appearance and quality of the product, it is estimated that only about one-quarter of the time is required for putting a given number of disks through this process and a little more than half the time is required for a given number of ingots or plates than was the case when gas-fired equipment was used with separate press and cooler.

▼

Canada Added Electric Goods in 1930 Worth $100,000,000

Production of electrical apparatus and supplies in Canada during 1930 was valued at $104,577,790, it is just reported by the Dominion Bureau of Statistics. There was a decline of 8 per cent as compared with $113,796,002, for the previous year.

The electrical supplies industry has shown great expansion in the past decade. Beginning with a value of $45,093,591 in 1921, the production dropped to $41,208,368 in 1922, then rose steadily to $51,360,400 in 1923, $60,158,837 in 1925, $78,558,730 in 1927, $93,672,452 in 1928 and $113,796,002 in 1929. The slight recession during the year under review was the first in eight years, and the 1930 output was more than double the value shown for 1923.

Characteristics of Flour Mill Loads

Data presented by Grover C. Meyer, industrial engineer of the Kansas City Power & Light Company, in his paper, "Flour Milling and Power Requirements," presented at the recent Kansas City meeting of the American Society of Mechanical Engineers, contains certain data that will undoubtedly be of value to power sales engineers in the solicitation of flour mills as customers for purchased energy. Of general value will be the table reproduced here and also the detailed statement of equipment drives in an actual mill which follows it.

Power Data on Flour Mills

Capacity of Mill (Bbl.)	Elevator Capacity (Bu.)	30-Min. Demand (Kw.)	R*	Yearly Kw.-Hr.	Output per Year (Bbl.)	Kw.-Hr per Bbl. of Flour
6,200	2,000,000	2,016	0.325	11,178,744	1,415,030	7.89
6,000	800,000	1,800	0.300	9,800,000	1,650,000	5.94
3,500	1,200,000	1,209	0.345	5,986,000	893,433	6.70
3,000	675,000	864	0.288	4,212,419	585,058	7.20
2,300	.....	600	0.261	3,899,900	622,917	5.26
2,000	.....	570	0.285	3,147,900	461,648	6.81
1,800	300,000	567	0.315	2,976,100	478,198	6.22
1,700	300,000	587	0.345	1,739,200	214,716	8.10
1,600	400,000	535	0.334	2,883,960	424,112	6.80
1,400	225,000	403	0.288	2,040,960	309,263	6.60
1,300	.....	340	0.262	1,951,300	334,026	5.84
1,200	350,000	357	0.297	1,713,600	272,000	6.30
1,200	250,000	362	0.302	1,073,884	145,119	7.40
900	.....	325	0.361	1,559,570	220,946	7.04
500	150,000	155	0.310	465,520	68,459	6.80
500	80,000	144	0.288	428,000	50,952	8.40
480	80,000	126	0.262	429,064	52,971	8.10
450	36,000	135	0.300	242,400	28,015	8.64

R = Ratio of kilowatt demand to capacity in barrels.

Power Data for Machines and Accessories

Capacity..... 1,050 bbl. per 24 hours
Wheat milled.....equal parts of hard spring, hard winter, red winter and Western white
Moisture content at first break 15 per cent
Hp.-hr. per bbl. of flour..... 7.19
Kw.-hr. per bbl. of flour..... 5.36

	Hp.
No. 1 motor.....	47.17
No. 2 motor.....	7.55
No. 3 motor.....	9.81
No. 4 motor.....	231.55
No. 5 motor.....	6.92
No. 6 motor.....	11.45
Total.....	314.45

Unit Machines and Accessories Connected to Motors

No. 1 Motor Delivering 47.17 Hp.

2 No. 87 Invincible 20th Century milling separators with fan shafts mounted in ball bearings.
2 No. 4 Invincible magnetic separators.
1 Oil tailing separator.
4 No. 5 Invincible single horizontal scourers with cylinders mounted in ball bearings.
1 No. 7 Invincible single horizontal scourer with cylinder mounted in ball bearings.
2 No. 3 D. H. & K. wheat heaters.
1 No. 30 ABC type A fan (ball bearing).
1 4½x3½ Gardner-Rix air compressor for water spray.
12 Elevators with 24 in. diameter head and boot pulleys, average 75 ft. 1-in. centers.
232 ft. of 6-in. steel conveyor.

No. 2 Motor Delivering 7.55 Hp.

2 32x8 round screenings reels with reel shafts mounted in ball bearings.
1 No. 2 Invincible magnetic separator.
4 Elevators with 24 ft. diameter head and boot pulleys, average 94-ft. 6-in. centers.
83 ft. of 6-in. steel conveyor.

No. 3 Motor Delivering 9.81 Hp.

1 No. 3 Gruendler ball bearing screener direct connected to motor; capacity 300 lb. wheat screenings per hour through No. 1 perforated case.

No. 4 Motor Delivering 231.55 Hp.

5 9x36 double roller machine with grooved rolls.
1 9x36 double roller machines with smooth rolls.
5 9x30 double roller machines with grooved rolls.
8 9x30 double roller machines with smooth rolls.
8 No. 1 Buckley scroll mills.
8 4x27 self-balancing square sifters.
1 20x8 differential reel with reel shaft mounted in ball bearings.
3 26x8 differential reels with reel shafts mounted in ball bearings.
4 32x8 differential reels with reel shafts mounted in ball bearings.
1 26x8 round reel with reel shaft mounted in ball bearings.
1 34x54 upright bran duster.
1 26x54 upright ship's duster.
1 20-in. centrifugal aspirator.
8 33x72 single sieve purifiers.
1 No. 25 ABC type A fan (ball bearing).
2 No. 4 ABC type WA fans (ball bearing).
3 No. 45 ABC type A fans (ball bearing).
1 4½x3½ Gardner-Rix air compressor for water spray.
42 elevators with 24-in. diameter head and boot pulleys, average 77 ft. 0 in. centers.
61 ft. of 6-in. steel conveyor.
372 ft. of 9-in. steel conveyor.

No. 5 Motor Delivering 6.92 Hp.

6 N & M friction clutch flour packers.
2 N & M friction clutch sack packers.

No. 6 Motor Delivering 11.4 Hp.

4 N & M friction clutch bran packers.

Roller machines have ball bearings and style "A" drives. Except where otherwise stated, all other unit machines have standard babbitt-lined bearings. All shafting mounted in Makutchan duplex roller bearings.

Mobile floodlighting with "Thyratron" control was used on the new Edison building

Heat Pump Shows

Large scale trial of reverse cycle refrigeration indicates great possibilities.

Southern California Edison Company installs complete air-conditioning plant in Los Angeles office building.

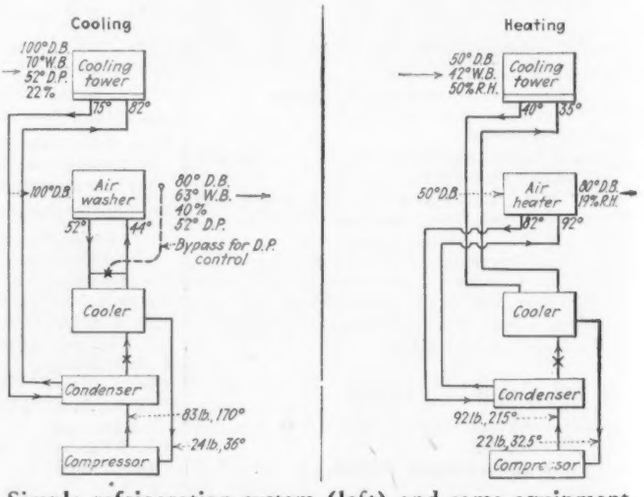
ALTHOUGH suggested by Lord Kelvin 75 years ago, it has been only in recent years that any great amount of development work has been done toward utilizing heat obtained by reversing the refrigeration cycle to warm buildings. The first large scale application of the heat pump, as it is sometimes called, is in the new thirteen-story, earthquake-proof office building of the Southern California Edison Company, Ltd., in Los Angeles.

Results of several months' operation of reverse cycle refrigeration in this building have fulfilled all expectations and indicate a great future for this latest step in providing complete air conditioning in office and commercial buildings.

The fundamental principles of the heat pump are well known and discussion will therefore be confined more to a brief description of the air-conditioning equipment installed in this most interesting building and to preliminary results. Theoretically efficiencies as high as ten to one and more are indicated in reversal of the refrigeration cycle, but practically from three to one to four to one is all that can be expected. In the Edison installation the atmosphere is the source of heat utilized. There are only two great reservoirs of heat available—the atmosphere and the ocean. Since it was not practicable to utilize the ocean nor any of the minor sources of heat, such as lakes or reservoirs, it was decided to draw heat from the atmosphere. It would have been entirely practicable to have taken heat from the water in the city mains, but it was considered advisable to utilize heat from the atmosphere in order to test the universal application of such an installation. The only limitation to the use of a commercial water supply is the lowering of the water temperature to freezing in case several installations were operating near by on the same main.

To provide the physical equipment necessary for summer cooling and winter heating, 480 tons of refrigeration was installed. This is in the form of four 120-ton compressors, each driven by a 200-hp. synchronous motor. Methyl chloride was chosen as the refrigerant, principally because it eliminated any possibility of ammonia fumes in the building and made possible the use of rotary compressors, with their lower pressure, simplicity, high efficiency and lack of vibration. These advantages were considered sufficient to more than offset any possible increase in power required over ammonia. Operating experience has shown that power requirements are much less than anticipated by either the manufacturer or the company, and that only slightly, if any, more power is required than would have been needed with ammonia. The compressors consist of pairs of herringbone gears operating with a glycerine seal, the glycerine being used over and over again. One of the accompanying illustrations shows the compactness of these compressors.

The equipment was installed primarily for cooling the ventilating air during the summer season. Its use for heating purposes required only the addition of fin-tube heaters, through which the hot condenser water is cir-



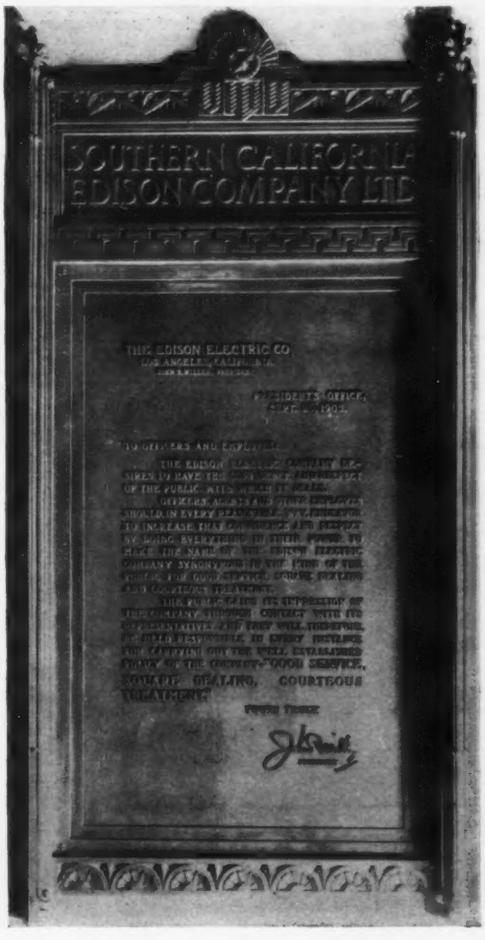
Simple refrigeration system (left) and same equipment used for heating (right)

2.8 Coefficient of Performance

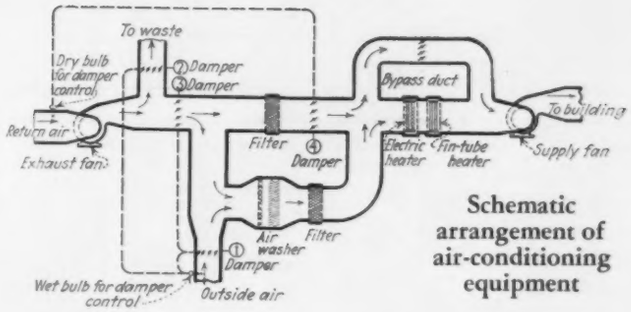
culated, and some extra piping and valves. The ventilating system is divided into two parts, one for the lower six floors and one for the upper seven floors. A heater was installed in the upper system only, in order to give the equipment a thorough trial under operating conditions. Operation up to the middle of this winter indicates that for every kilowatt-hour expended in the system the equivalent of 2.1 kw.-hr. is liberated in the form of useful heat in the building. If a heater had been installed in the lower ventilating system and the capacity of the refrigeration equipment thus more fully utilized, this figure, it is estimated, would be about 2.8 kw.-hr., due to the fixed power requirements of auxiliary equipment, such as water pumps, etc. This type of equipment is most efficient under mild climatic conditions and is therefore particularly adaptable to southern California.

The building has a content of 3,778,000 cu.ft. and a gross floor area of 269,000 sq.ft. Due to the size of the building the ventilating system was divided into three parts. The basement system previously mentioned is divided into two parts, one for the lower six floors of the building and one for the auditorium. The combined capacity of the three systems is 193,000 cu.ft. per minute, which provides six changes of air per hour. General arrangement of the ventilating system is shown by one of the accompanying drawings.

There are four two-pass condensers and two 40-hp. 900-g.p.m. pumps for handling the condensing water. Two special washers are installed on the roof, used as forced-draft cooling towers for the refrigeration cycle and for absorbing heat from the air when the reversed cycle is used for heating. Dampers and by-passes are operated entirely automatically by dry-bulb and wet-bulb thermometers. Water supplied to the air washers is automatically maintained at the proper temperature for humidity control. Air washers and cooling



Ideals of the Edison company as set forth on this tablet in the lobby of its new building have not changed in 26 years



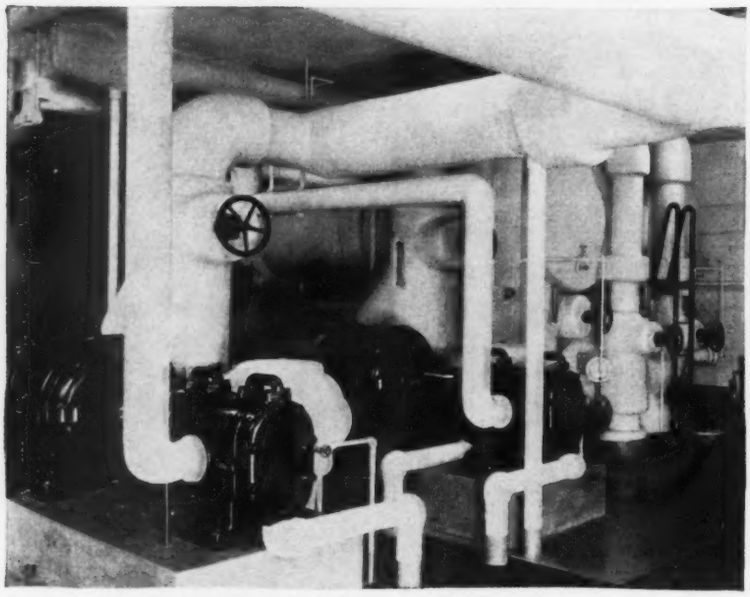
Schematic arrangement of air-conditioning equipment

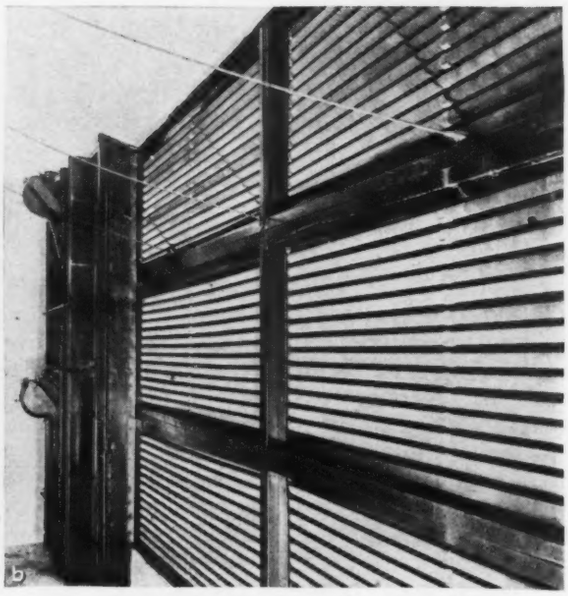
equipment are so designed as to maintain a building temperature of 15 to 20 deg. below outside temperature. This has been found to be the maximum practicable difference for the climate of southern California.

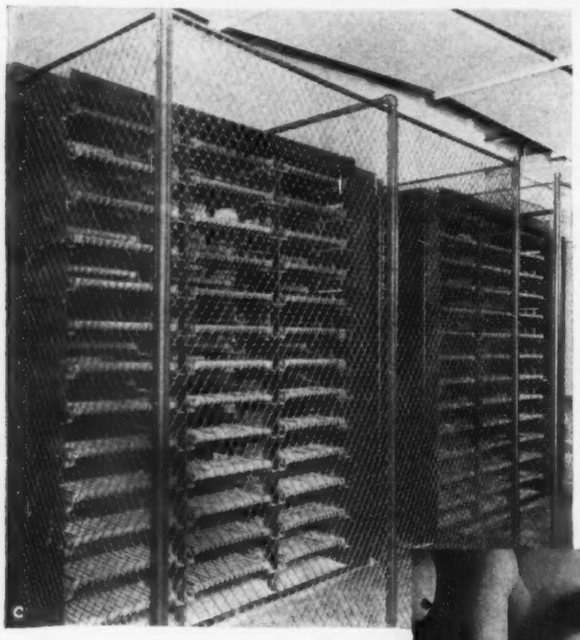
In addition to the heat obtained by reversed refrigeration, two systems of electric heat were provided. One is an indirect system consisting of industrial type strip heaters installed in the air duct system. There are three banks of such heaters, one on the roof for the upper seven floors and two in the basement, one for the lower portion of the building and one for the auditorium. These banks consist of three 3.8-kw., 110-volt ribbon-type units, connected in series on 440 volts, thus giving a little more than 20 kw. per set of three. Capacities of the three groups of heaters are: Tower, 611 kw.; basement, 856 kw., and auditorium, 125 kw., or a total of 1,589 kw. Temperature control is automatic in six ½-deg. steps, interlocked with the fan control.

Besides these centrally located electric heaters in the air-duct system, additional heat is supplied by 739 direct heaters located in the individual offices. These range in size from 1½ kw. to 5 kw., the majority being of 1½ kw. capacity. The total connected load for these heaters is 1,329 kw. Each heater is provided with a single-pole thermostat, permitting a refinement in temperature regulations to suit individual needs. Heaters are rated at 220 volts and service is supplied by a 220-volt, three-phase system.

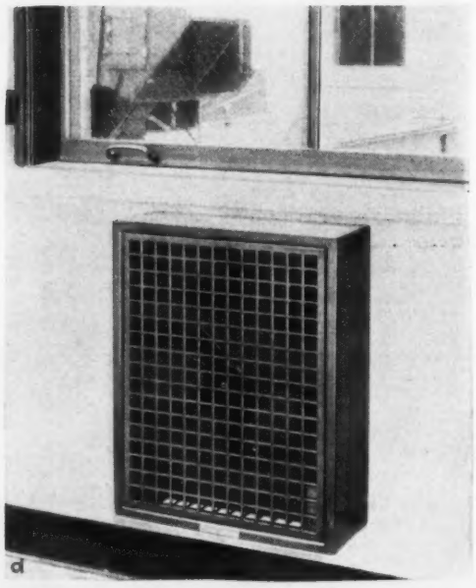
In operation, the reversed cycle refrigeration fin-tube heaters in the tower and the electric heaters in the air-duct system in the basement are used to warm up the building in the morning and to keep the temperature of the ventilating air from failing

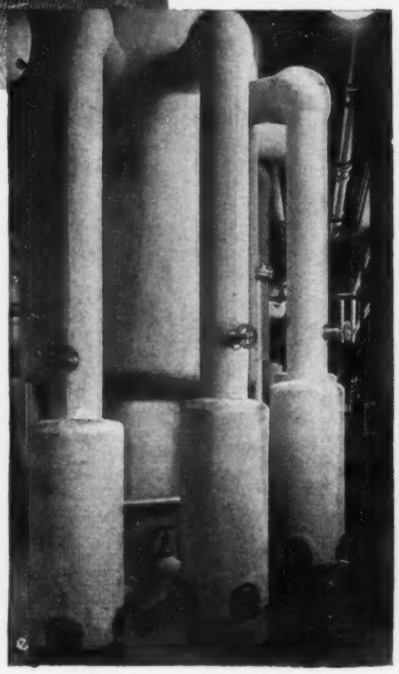


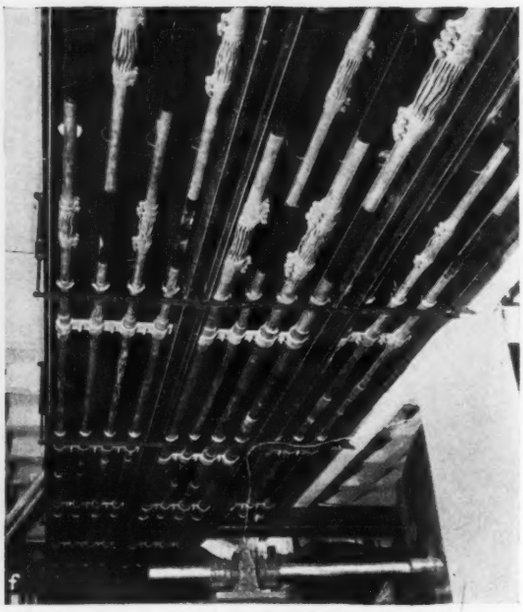




Some of the Equipment Involved in Conditioning Air for Los Angeles Building







(a) Corner of compact compressor room showing two of the four 120-ton rotary compressors driven by 200-hp. synchronous motors.

(b) Hot water is circulated through fin-tube heaters for building heating by reversing the refrigeration cycle.

(c) Ribbon type electric heaters in the ventilating ducts heat lower portion of building.

(d) Individual requirements and varying exposure are provided for by individual room heaters. All windows are locked closed.

(e) Battery of electric hot water heaters.

(f) Tubular copper buses provide high capacity for space occupied.

Mechanical Equipment in New Edison Building

Basement System

Equipment	Size and Capacity	Make
Supply fan	105,000 c.f.m. at 1½ in. static, 30-hp. motor	No. 175 Sturtevant silentvane
Exhaust fan	103,000 c.f.m. at ¾ in. static, 25-hp. motor	No. 170 Sturtevant silentvane
Air washer	65,000 c.f.m., 18x9x9 ft.	Sturtevant type C
Air washer pump	800 g.p.m., 15-hp. motor	Byron Jackson Co.
Water circulating pump for basement cooler	800 g.p.m., 25-hp. motor	Byron Jackson Co.
Water circulating pump for tower cooler	610 g.p.m., 40-hp. motor	Byron Jackson Co.
Water circulating pump for auditorium cooler	90 g.p.m., 5-hp. motor	Byron Jackson Co.
Two condenser water pumps	900 g.p.m. each, 40-hp. motors	Byron Jackson Co.
Air filters	1 — 2½ section 12 ft. x 10 ft. 10 in. wide 1 — 5½ section 9 ft. x 24 ft. 1 in. wide	No. 48 Reed multi-panel
Indirect heaters	856 kw., 440 volt	G. E. ribbon type
Four refrigerating compressors	120 tons each, 1,000 r.p.m., 200-hp. motors	Sturtevant
Four condensers	2,790 sq.ft. each ¾-in. admiralty tubes	C. F. Braun Co.
Basement cooler	3,000 sq.ft. surface	Sturtevant
Tower cooler	2,250 sq.ft. surface	Sturtevant
Auditorium cooler	375 sq.ft. surface	Sturtevant

Tower System

Supply fan	78,000 c.f.m. at 1½ in. static, 25-hp. motor	No. 170 Sturtevant silentvane
Exhaust fan	77,000 c.f.m. at ⅞ in. static, 20-hp. motor	No. 165 Sturtevant silentvane
Two cooling towers	900 g.p.m. water, each 21 ft. x 12 ft. 6 in., 15 ft. long	Sturtevant special type C air washer
Two cooling tower fans	130,000 c.f.m. each, 50-hp. motors	No. 17 Sturtevant multivane
Two cooling tower pumps	900 g.p.m. each, 20-hp. motors	Byron Jackson Co.
Air washer pump	610 g.p.m., 10-hp. motor	Byron Jackson Co.
Air heater	Eighteen W82 four-tube sections Superfin fan-blast radiation	York Heating and Ventilating Co.
Air washer	50,400 c.f.m. 14x9x9 ft. long	Sturtevant type C
Indirect heater	611 kw., 440 volt	G. E. ribbon type
Toilet exhaust fan	20,000 c.f.m. at 2 in. static, 5-hp. motor	No. 125 Sturtevant silentvane
Air filter	1 — 3 section 11 ft. 6 in. x 12 ft. 4 in. wide 1 — 2 section 11 ft. x 8 ft. 2 in. wide	No. 48 Reed multi-panel

Auditorium System

Supply fan	10,000 c.f.m., 3-hp. motor	No. 110 Sturtevant silentvane
Exhaust fan	7,500 c.f.m., 2-hp. motor	No. 95 Sturtevant silentvane
Indirect heater	125 kw., 440 volt	G. E. ribbon type
Air washer	6,400 c.f.m., 4x4x9 ft. long	Sturtevant type C
Air filter	1 — 1½ section 6 ft. x 6 ft. 8 in. wide	No. 48 Reed multi-panel

below a predetermined value. The final heating is taken care of by the direct units in each office. In this way unequal requirements, due to sun or wind exposure or heat produced by interior lighting, are compensated for.

Every facility has been provided to record all important data on performance and costs and after a year's operation some very valuable facts should be available.

From the foregoing it will be seen that the building contains a complete year-around air-conditioning plant entirely electrically operated. In addition, drinking water is electrically cooled and wash water is electrically heated for the entire building. Other features include: Latest practice in illumination, a complete under-floor duct system for electric, telephone and signal circuits, "Thyratron" controlled floodlighting, high-speed automatic elevators; Telechron clocks and radio outlets.

Maximum demand for the building as a whole for the present winter has been approximately 2,000 kw. To supply such a large load required careful planning of the distribution system within the building. Service is supplied by transformer banks located in vaults under the sidewalk. Lighting service is furnished by a bank of three 200-kva. transformers supplying 120/208-volt, three-phase, four-wire service, with one 75-kva. transformer for emergency lighting. General power and indirect heating is supplied by two banks of three 333-kva., 440-volt, three-phase transformers operated in parallel. Three 333-kva., 220-volt, three-phase transformers supply the direct heaters.

Distribution from the main board is featured by use of tubular copper buses for the 220- and 440-volt feeders. These run 150 ft. across the basement ceiling to the riser shaft, where they connect to similar buses running to the top of the building. This system has the advantage of ease of making taps and high capacity for the space occupied. The buses are inclosed in an ebony asbestos housing which is connected to the ventilating system and any heat losses are used to help heat the building.

The building itself is architecturally pleasing from without and quiet and conducive to high working efficiency from within. It stands as a monument of security and progress to the Edison company's 500,000 patrons and its 125,000 customer owners in southern California.

▼

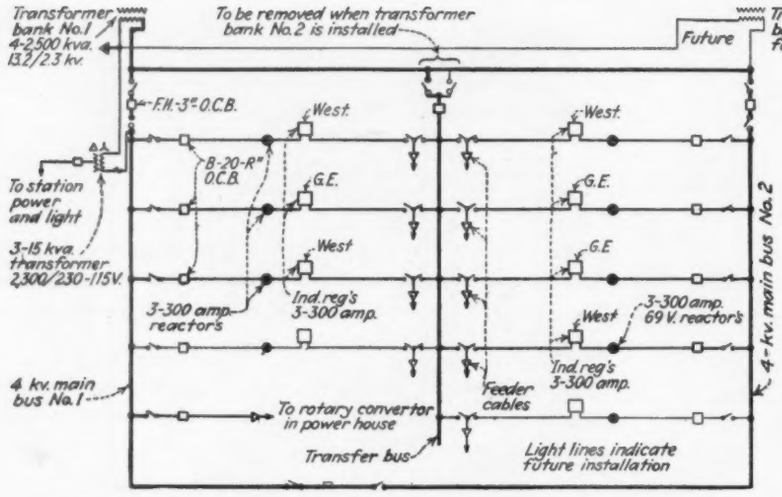
Vacuum Casting Improved to Eliminate Voids

Metals of exceedingly high purity and soundness are now being produced through a vacuum-casting process developed by the Bell Telephone Laboratories. While vacuum casting is not entirely new, it has involved distinct disadvantages heretofore, and a method which would involve the least possible amount of piping voids has offered a problem of great interest. These difficulties have been, it is said, successfully solved. In the method now used at the Bell Telephone Laboratories, a 35-kva. high-frequency inductor-coil type of furnace is mounted on an asbestos board capable of being tilted through a little over 90 deg. A vacuum is applied to the apparatus and the metal is melted in a few minutes. The crucible is then raised to the pouring position with the current and vacuum both on. The whole apparatus is then tilted over and the metal runs into the mold and solidifies immediately. As soon as the casting has cooled sufficiently the pump is stopped and the apparatus reduced to atmospheric pressure. Such an operation can be completed in not more than half an hour with platinum or its alloys; lower melting metals, such as nickel or copper alloys, require less time. An essential feature of the operation is the selection of the proper crucible, of quartz or alundum, sometimes with zirconia powder, to avoid occlusion of gases.

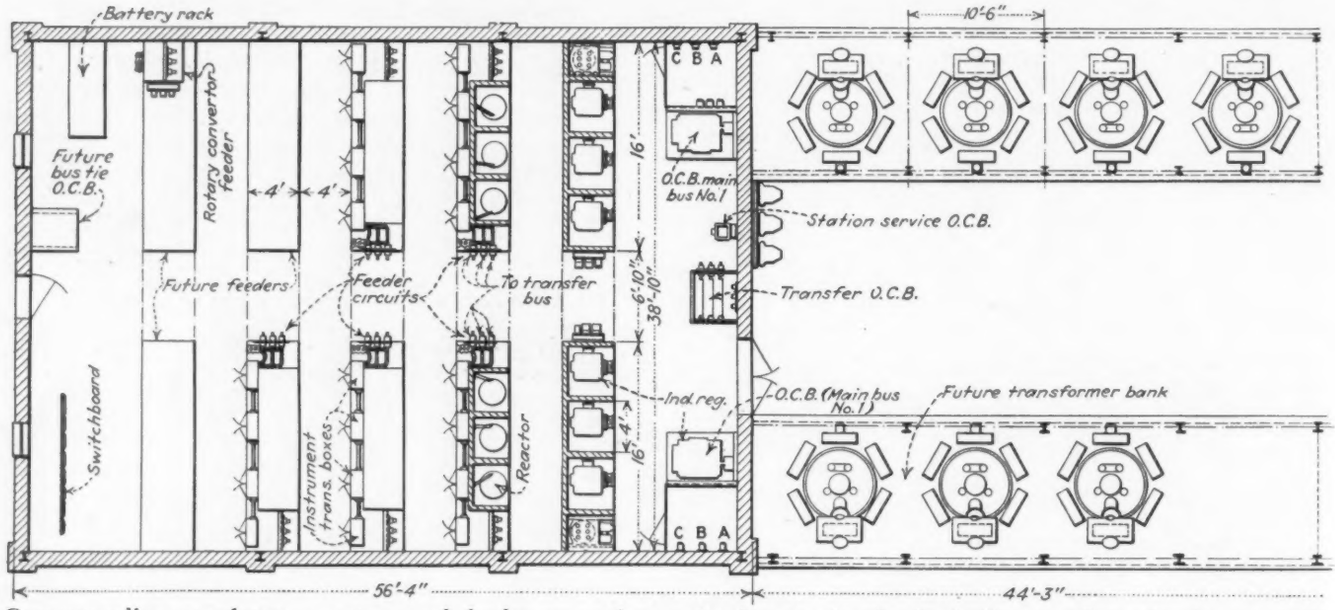
Vacuum melted ingots ½ in. diameter and weighing about 500 grams, after cropping off the head, have been repeatedly drawn to 0.003 in. in one continuous length of wire without breakage. This is considered one of the best proofs that the vacuum cast ingots are sound and free from cavities.

Simplicity in Distribution Substation Design

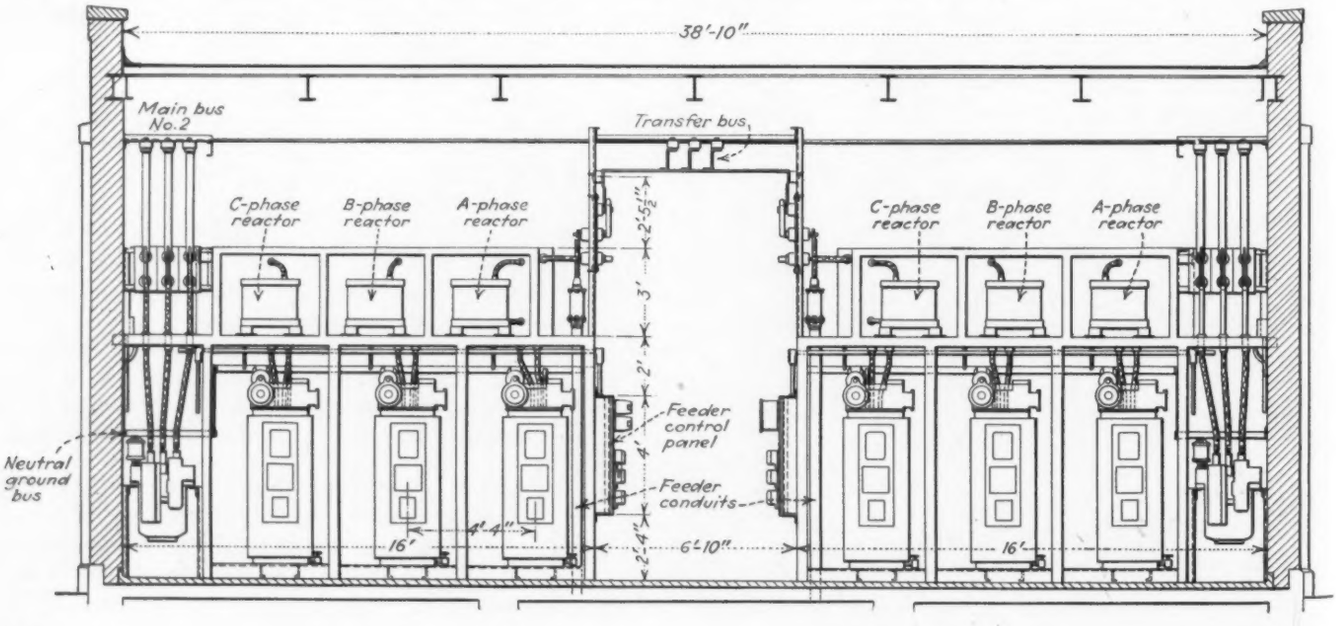
Fundamental design consisting of a bus arrangement that is said to result in simplicity of operation and economy of construction and have definite safety features characterizes the new Marshall substation laid out for the Northern States Power Company, Minneapolis, Minn., by the Byllesby Engineering & Management Corporation. Essentially the switching equipment is inclosed in a rectangular main bus with a transfer bus dividing it



Switching equipment is inclosed in rectangular main bus divided in half by transfer bus



Corresponding regulators, reactors and feeder control are closely associated physically to effect circuit economies



in half. The development of this idea, with some of its advantages, is exposed in the accompanying drawings.

In the top view the distribution feeder positions extend from the outer main buses to the center aisle of the building along which the transfer bus runs. Outgoing feeder cables line this aisle. Throw-over disconnecting switches permit any feeder to take energy from the transfer bus, which may either be connected to the main bus or be regulated through a spare feeder position.

In the illustration in the center each feeder position is a complete unit with individual control, relay and meter panel at the aisle end of the structure. This effects a major economy in secondary wiring which does not have to be carried to a central control board. A safety feature of this layout is the inclosure at top and on three sides of the single-phase regulators. The open side of each regulator cell faces the blank back wall of the adjacent circuit structure. Thus a regulator fire accompanied by oil spilling is effectively inclosed without being dangerously confined.

The circuit buses in the bottom drawing are carried along the side, near the top, of each position and are tapped down to the oil circuit breaker, through the reactors and regulators to the feeder selector disconnects. This section shows another detail of the safety feature. Each regulator cell is closed off with a sill high enough to retain in the compartment all of the regulator oil.

▼

Dialing Controls Signals on Power Supervisor's Board

Most of the system operator boards which have automatic control of signals thereon are controlled by keys, of which there is one for each device. The Westchester Lighting Company's new operator's board, however, is controlled entirely by a telephone dial from the operator's desk. No part is operated manually, so the operator never has to leave his desk to throw a switch, place a signal tag, or plug in a signal light.

Consider a specific example:

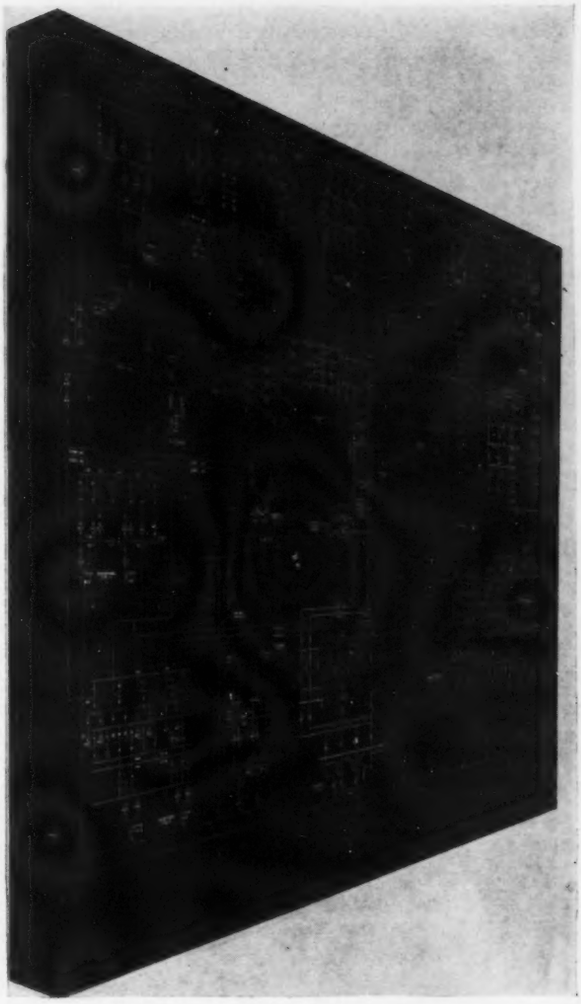
The operator wishes to register on the board that a certain switch has been closed, and, therefore, to change the color of the specific switch target from green to red. As in a telephone call, he first dials the number of the station on the board, say No. 13 (Peekskill station number). Then he dials, let us say, No. 661 (a feeder number). The next dialing gives actual and specific switch number (let us say No. 1).

These numbers are flashed before the operator on a glass-paneled board on his operator's desk, serving to show the accuracy or error of his dialing before he proceeds further.

The pressing of a small "operating button" on the desk will connect his dial to a new set of wires which will permit him to operate the switch target or signal. If the switch is closed, and the target appears red, the switch will be opened by dialing four digits or No. 4 on the dial.

The face of the board is made up of thousands of small square escutcheons that can be inserted or withdrawn from any section of the board at will to adapt the representation of lines and equipment thereon to changed system conditions.

Changeable signals, called targets, appear at openings on the board where switches are located. These are not lights but vari-colored cylinders which, when operated, show various colors on the face of the board.



Changeable color targets and small, replaceable escutcheons are features of this board

Auxiliary lamps in the form of red lamps also appear on the feeder lines, main buses and transformers, shown on the board. For feeders and main buses, a steady red light indicates they are "in service"—a blinking red light that they are "held off." For transformers, a steady red light indicates "in service," a dark lamp indicates "out of service."

The board is known as the Strowger power supervisor's board and with its accessory equipment was furnished by Automatic Electric, Inc.

▼

Credit Misdirected

Through an editorial inadvertency due to pressure of copy preparation during the midwinter convention, A.I.E.E., in January there appeared in ELECTRICAL WORLD, February 6, 1932, in the running reports of the "Symposium on Distribution Circuit Lightning Protection" and of the opening session on "Electrical Machinery" references to a suggestion, stated as made by F. W. Peek, Jr., and concurred in by C. L. Fortescue, that the Institute consider the promulgation of standard impulse and high-frequency tests for transformers in addition to the present normal frequency test now alone required by Institute standards. In fairness it should be

pointed out that the original suggestion for such tests, as was recognized by Mr. Peek in his remarks, appears in the paper by D. W. Roper which was presented in the distribution circuit lightning symposium.

▼

READERS' FORUM

Claims Jacksonville Municipal Makes Profit Instead of Loss

To the Editor of the ELECTRICAL WORLD:

I have read with much interest W. Austin Smith's article in the January 30 issue, entitled "Municipal Utilities Increase Florida Tax Burden." The fallacies of this article are so obvious that I consider it necessary to answer only the most outstanding inaccuracies.

Regardless of bookkeeping systems, no one can deny the fact that we have turned over to the general fund for reduction of taxes $6,871,410; our Jacksonville plant, which is today valued at $9,500,903.41, has been constructed out of net earnings, except $1,602,500 which we owe on bonds. These figures show that the people have made $14,769,813.41, which no one can deny to be net profits.

Our records show that the gross revenue of the plant since 1895 is $31,007,704.10. Comparing actual bills from every section in the state against bills for the same classes of service in Jacksonville, I find rates charged by private companies in Florida average 96.8 per cent higher than ours. Through these lower rates our citizens have saved $30,015,457.57. This is based on the present rate schedules, although when our plant was built, and for many years afterward, our rates were from 100 per cent to 500 per cent* lower than the rates of private companies. At the time we built our plant the private power company was charging 28 cents per kilowatt-hour, and the first rate established by the municipal plant was 7 cents per kilowatt-hour, which is still in effect.

I note that Mr. Smith, in figuring losses sustained by the Jacksonville plant, has compared the national average revenue per kilowatt-hour, Georgia Power average and Alabama Power average with what he claims to be Jacksonville's average. I do not agree that this is the proper method of comparing rates, as any one in the power business knows the only fair way is to compare rates charged by two companies for the same classes of service. Every one knows that the Georgia and Alabama Power Companies sell most of their current to large wholesale users, while our load is practically all retail sales and our average revenue per kilowatt-hour would naturally be higher.

Mr. Smith says our citizens lost money by paying Jacksonville rates. If he had used the average revenue received per kilowatt-hour by power companies operating in Florida, which have load conditions similar to ours, the story would be quite different. Mr. Smith made no comparison on water rates. A survey by the Water Supply Commission, composed of three prominent bankers, one well-known attorney and our former Commissioner of Utilities, showed that Jacksonville's water rates are 50 per cent lower than those charged in 295 other American cities serving 42,000,000 population.

In making the following analysis of our electric plant and water works earnings, I am using the same method of arriving at my figures as Mr. Smith used, with the exception that I am comparing Jacksonville rates to those charged by privately owned companies in Florida for the same classes of service. I am allowing a depreciation charge of 5 per cent, although I feel that this charge on a municipal plant is merely a question of whether the citizens who have their money invested wish to enjoy the full profits through reduction of taxes or wish to set aside certain sums to rebuild the plant for posterity. I have never seen any power company report which charged full 5 per cent depreciation. On the water works I am allowing 2¼ per cent depreciation, which is the per cent generally used by all water companies.

On the 1930 statement of a private power company operating in Florida, which has a book value of $25,800,000, a plant of similar size and about the same output as Jacksonville's, it is shown that city, county and state taxes amounted to approximately $105,000 for 1930. Computing taxes on the same ratio, and using net assets of our plant in 1930, which were $7,258,673.37, our taxes would have been 28 per cent of $105,000, or $29,400. On the water works, which had net assets of $1,860,638.95 in 1930, taxes would have been $7,350.

	Electric	Water	Combined
Gross earnings for year 1930	$2,730,499.26	$442,662.69	$3,173,161.95
Less actual operating expenses	614,417.20	148,452.78	762,869.98
	$2,116,082.06	$292,209.91	$2,410,291.97
Less maintenance and replacements, a large amount of which is chargeable to depreciation	388,349.54	78,167.05	466,516.59
	$1,727,732.52	$216,042.86	$1,943,775.38
Less depreciation			
5 per cent on electric except real estate	424,726.79	.....	.....
2¼ per cent on waterworks except real estate	.....	58,330.22	483,057.01
	$1,303,005.73	$157,712.64	$1,460,718.37
Interest on outstanding bonds*	99,625.00	66,075.00	165,700.00
	$1,203,380.73	$91,637.64	$1,295,018.37
Taxes	29,400.00	7,350.00	36,750.00
	$1,173,980.73	$84,287.64	$1,258,268.37
Plus saving in rates			
96.8 per cent on electric rates	2,643,123.28	.....	.....
50 per cent on water rates	.....	221,331.35	2,864,454.63
	$3,817,104.01	$305,618.99	$4,122,723.00
Actual saving to people in low rates, combined with net earnings, equals a millage of (1 mill raises $94,000 in taxes)	40.61	3.25	43.86

*Since the assets of the plant were earned by the plant, an interest charge on the investment would make no change in the above figures, as the plant would also receive credit on earnings for the interest.

It is understood that the above figures are arrived at on the same basis as Mr. Smith used, but our records show the net earnings were $1,727,732.52 on electric plant and $216,042.86 on water works.

Naturally there will always be discrepancies between the methods used by the privately owned power companies and municipally owned companies in arriving at net earnings, because it is the policy of the private companies to charge everything possible to operating expenses, in order to show as small net earnings as possible, so they may retain their present rates or request increases, whereas the municipal plant tries to show as large net earnings as possible in order to give the people the lowest rate that good business will justify.

ERNEST E. ANDERS,
Commissioner Public Utilities.

Jacksonville, Fla.

**Author's exact statement.*

Men of the Industry

Moore Heads Southern New England Power Properties

Samuel C. Moore, vice-president of the New England Power Association, Boston, has been elected president of the Rhode Island Public Service Company, assuming charge of all association activities in the southern district. His headquarters will be at Providence, R. I. The major operating properties included in this group embrace the Narragansett Electric Company, United Electric Railways Company, Fall River Electric Light Company and South Counties Public Service Company.

Arthur E. Pope, vice-president of the association, with headquarters at Boston, has been elected president of the New England Power Company, the principal wholesale generating and distributing unit of the organization in central New England.

▼

HAROLD SMITH, vice-president of the Westinghouse Electric & Manufacturing Company, has been elected a member of the board of the Radio Corporation of America to fill the vacancy caused by the recent death of H. P. Davis.

•

F. D. SHAFFER, vice-president and safety director of the Southwestern Light & Power Company at Chickasha, has retired from active service. He will reside in Lawton. Mr. Shaffer has been in utility service since 1890. He went to Chickasha in 1913 as manager of the Chickasha Gas & Electric Company, later purchased by the Southwestern Light & Power Company.

•

D. W. DEAN has recently been appointed manager of the control section of the industrial department of the Westinghouse Electric & Manufacturing Company to succeed the late W. H. MacGillivray. Upon graduation from the Ohio State University in 1921 Mr. Dean entered the employ of the Westinghouse company. After completing the Westinghouse student training course in 1922 he became a member of the steel mill section of the general engineering department, a position he held until his recent appointment. He is an active member of the Association of Iron and Steel Electrical Engineers and is the author of a number of papers on control equipment which have been published in various trade and scientific magazines. Mr. Dean is recognized as an authority on the design and application of steel mill equipment. Various patents on synchronizing roll table speeds, flying shear control and methods of maintaining tension between stands on tandem mills have been granted to him. Also, he has done considerable work on cold strip mills, reel drives and auxiliary drives. His present duties will enable him to expand his activities to include an active part in the standardization of control apparatus.

OSWALD RYAN of Anderson, Ind., has been selected by the Federal Power Commission to be its chief counsel. A graudate of the Harvard Law School, Mr. Ryan has been active in the politics of the progressive wing of the Republican party. He represented the city of Anderson in the state-wide investigation of the Indiana Bell Telephone Company and was special counsel for the public in cases involving the public regulation of the jitney bus. He also served as counsel for the Indiana Union Traction Company. He was a member and legal adviser of the European Immigration Committee, which studied economic and immigration conditions in various European countries in 1923.

▼ ▼ ▼

Kehoe and Tapscott New Vice-Presidents of New York Utility

Arthur H. Kehoe, electrical engineer of the United Electric Light & Power Company, and Ralph H. Tapscott, electrical engineer of the New York Edison Company, both of whom were elected vice-presidents of the United organization, as announced in the February 13 issue of the ELECTRICAL WORLD, have had many years of experience with the New York utilities.

A. H. Kehoe

Mr. Kehoe was still a student at the University of Vermont when he entered upon his public utility career in the meter and inside construction departments of the Twin State Gas & Electric Company. After completing his engineering course he became identified with the United organization in 1911. He spent eight years in miscellaneous engineering work and was then appointed superintendent of transmission and distribution for the company. It was in 1921 that he was named electrical engineer, the position he occupied at the time of his recent election to the office of vice-president. In the course of his career Mr. Kehoe has worked out several developments of alternating-current distribution systems. He is a fellow of the American Institute of Electrical Engineers and chairman of the Engineering National Section of the National Electric Light Association and for both of these organizations he has frequently written papers on technical subjects.

Mr. Tapscott received his preliminary engineering training with the General Electric Company, following graduation from Union College in 1909. At first he was connected with the testing department, but in a short time he was transferred to the lighting engineering department, where he formed a contact with the New York group of utilities. In the fall of 1917 Mr. Tapscott resigned from the General Electric Company to become assistant chief electrical engineer of the New York Edison Company and in 1925 he was made electrical engineer of that company. Mr. Tapscott has been active in association work, especially in the American Institute of Electrical Engineers and the National Electric Light Association.

R. H. Tapscott

▼

H. HOBART PORTER of New York has been re-elected chairman of the Engineering Foundation, research organization of the national societies of civil, mining and metallurgical, mechanical and electrical engineers. Mr. Porter is president of the American Water Works & Electric Company, chairman of the board of the West Penn Electric Company and a director in numerous railroads and public utility enterprises.

R. M. Feustel New President of Midland United

Robert M. Feustel, recently elected president of the Midland United Company, has been actively engaged in the public utility business as an operator, management executive, state commission engineer and consulting engineer since his graduation from Purdue University in 1905. He began his professional career as assistant engineer with the Fort Wayne & Wabash Valley Traction Company at Fort Wayne in that year. In 1907 he became assistant engineer of the Railroad Commission of Wisconsin and there gained training with the first state public utility regulatory body given mandatory power over rates and service. He became assistant chief engineer in 1911. When the Public Utilities Commission of Illinois was created, two years later, he was called to that state to become its first chief engineer and in that capacity organized its engineering department.

Mr. Feustel left commission work in 1915 to engage in private consulting engineering, which he continued until 1929. In 1917 he was elected president of the Indiana Service Corporation, with headquarters at Fort Wayne, a position which he still retains. While thus actively engaged as a public utility operator Mr. Feustel served almost continuously during the next twelve years in consulting engineering and valuation work for both public bodies and public utility companies. Although he was engaged in directing the operation of a public utility company, Mr. Feustel, during that period, served as an expert for state public utility commissions, municipalities and the provincial and Dominion governments of Canada.

While engaged in valuation and rate engineering work Mr. Feustel published about a dozen reports upon investigations of the Pittsburgh Railways Company, Philadelphia Rapid Transit Company, Public Service Corporation of New Jersey and other utility properties.

In 1929 Mr. Feustel was elected executive vice-president of the Midland United Company, which controls the Indiana Service Corporation and other companies operating in Indiana and Ohio. In the following year he was elected an officer of other subsidiary companies in the group. Recently he was elected president of the Midland United Company and a director of the Northern Indiana Public Service Company.

▼

OBITUARY

W. H. Hoover, founder of the vacuum sweeper company that bears his name, died February 25, at his home in North Canton, Ohio, in his eighty-third year. Mr. Hoover had retired several years ago, turning the business over to his sons. He was born in Canton and was graduated from Mount Union College in Alliance. After spending many years in the tanning business, he began the manufacture of vacuum sweepers in 1907. In 1922 the company was reorganized and Mr. Hoover became chairman of the board, subsequently retiring from active business life.

•

Dr. Lewis E. Gould, who with his father, ex-United States Senator Arthur Gould, was identified with hydro-electric operations in the State of Maine, died recently in Boston, following an operation. Dr. Gould was born in Bangor, Me., in 1883 and was graduated from a Baltimore medical school. He practiced at Bangor, and later at Surry, Me., for less than two years, being called on to join his father as manager of the Maine & New Brunswick Power Company. He occupied this office until the company was an entity in a merger. At the time of his death he was vice-president of the Aroostook Valley Railway Company, operating on both sides of the Maine-New Brunswick border, in the northern section, and also operating a 32-mile electric railway. The father and son participated in the hydro-electric development at Aroostook Falls, on the border, furnishing current to within about 50 miles.

•

William T. Walker, construction superintendent Northern States Power Company, died suddenly, February 25, at Grand Forks, N. D. Death was caused by uremic poisoning six hours after he had become afflicted. With the passing of Mr. Walker the Northwest loses one of its outstanding construction engineers. He was a nationally prominent figure in the electrical progress and development of electrical service in the Northwest. A native of Lawrence, Kan., and a graduate of the University of Kansas, he became associated with the Byllesby organization in March of 1910; the following month he was assigned to construction work on the Rapidan hydro-electric plant, and took up his residence in Minneapolis. During the 22 years that followed he acted as construction superintendent for a number of projects, the more prominent of which were Riverside steam station, High Bridge steam station, Granite Falls steam station, Coon Rapids hydro plant, Chippewa Falls hydro plant and other construction projects of the Northern States Power Company.

•

Burrows Sloan, chairman of the board of the General Refractories Company, Philadelphia, Pa., and a business associate of the late Governor Sproule of Pennsylvania, died February 28, in his fifty-fifth year. Mr. Sloan was widely known in the iron and steel industry. Following his graduation from Princeton in 1899, he was employed by the Reading Company and later became associated with the Harbison-Walker Refractories Company in Pittsburgh. In 1911, with Governor Sproule, he organized the General Refractories Company at Philadelphia. He became president of the company in 1925 and was named chairman of the board in 1931.

•

M. Fernand Jacopozzi, who directed the illumination of the Eiffel Tower and the floodlighting of various spots in Paris, died recently, at the age of 54. He was a Florentine by birth, but left his native country for France some 30 years ago. It was the introduction of electric lighting that gave Jacopozzi his great opportunity. He saw the possibilities of the new system at once and took a leading part in its application to lighting on a large scale. Nevertheless he remained unknown to the general public until M. Citroen acquired the right to advertise his cars from the Eiffel Tower. Jacopozzi was put in charge of the arrangements. Meanwhile he had also been busy with various schemes of floodlighting, and finally, again co-operating with M. Citroen, undertook, as an experiment, the lighting of the Arc de Triomphe. It proved such a success that further installations in the Place de la Concorde, at the Madeleine and at various other points followed. Many of the criticisms made against floodlighting as a whole could not be applied to M. Jacopozzi's work. Partly by skill, but even more by instinct, he avoided the dangers of unrelieved glare and the loss of shadows and, as a result, he gave a new and different beauty to the Parisian scene. His last completed achievement was the floodlighting of the Colonial Exposition.

Trade News

Link Belt's Net Totals $638,974

Net profit of the Link Belt Company. after charges, federal taxes and depreciation, total $638,974 for the year ended December 31, 1931, equivalent after preferred dividends to 54 cents a share on 709,177 common shares, compared with $2,310,332, or $2.89 a share, in 1930.

▼

Claude Neon Electrical Products Corporation, Ltd., and subsidiaries, reports for the year ended December 31, 1931, net profit of $664,895 after charges and federal taxes, against $743,418 for the previous year.

•

The annual report of the Allgemeine Elektrizitätsgesellschaft shows a decline in turnover of 30 per cent to $88,000,000. This leaves the company with a net loss of more than $4,500,000 for the year.

•

Worthington Pump & Machinery Corporation has decided to defer the regular quarterly dividends of 1¾ per cent on the 7 per cent cumulative preferred A stock and of 1½ per cent on the 6 per cent cumulative preferred B stock, both of which are due April 1.

•

Syracuse Washing Machine Corporation, Syracuse, N. Y., has secured volume business for motor-driven washing machines to insure a full-time, five-day-week operating schedule, giving employment to 1,000 workers.

•

Corning Glass Works announces the appointment of A. J. Heisel, with offices in New Orleans, La., as its agent for the sale of "Pyrex" power insulators. Mr. Heisel will cover the states of Louisiana and Mississippi.

•

Directors of the Aluminum Company of America have declared a dividend of three-quarters of 1 per cent on the 6 per cent cumulative preferred stock, par $100, payable April 1. Previously regular quarterly distributions of $1.50 per share were made on this issue.

•

Announcement has been made that M. F. Mahony, manager of the sales operations division of the General Electric refrigeration department, has been appointed manager of the merchandising division. Mr. Mahony's appointment fills the vacancy caused last New Year's Eve by the death of A. C. Mayer, when the plane in which he was flying to his home in Louisville, Ky., crashed near Springfield, Ohio. The sales operations division will remain under Mr. Mahony's management.

•

For the year ended December 31, 1931, Sangamo Electric Company reports net profit after charges and taxes amounting to $393,540, equivalent after preferred dividends to $2.65 a share on 125,000 common shares, against $364,015, or $2.35 a share, in 1930.

•

Johns-Manville Corporation has voted to omit the quarterly dividend on the common stock. In the preceding quarter 25 cents was paid, previous to which the stock was on a $3 annual basis.

•

Henry N. Hudson, for several years water heating engineer of the Central Maine Power Company, Augusta, Me., has been appointed New England sales representative of the Automatic Electric Heater Company, Philadelphia. His headquarters will be at 29 West Street, Worcester, Mass. Arthur H. Abbott, Winchester, Mass., who formerly handled this account in the northeast, has been retained in a consulting capacity.

Air Conditioning as an Aid to Efficiency

Human beings can do four times as much work in a temperature of 100 deg. when the relative humidity is 30 per cent than when it is 100 per cent and can perform at maximum efficiency only between the temperature limits of 40 deg. and 75 deg. F., according to facts quoted in a report just issued by the Policyholders' Service Bureau of the Metropolitan Life Insurance Company, entitled "Air Conditions and the Comfort of Workers." The booklet offers a very interesting and instructive compilation of data on the merits of air conditioning.

▼

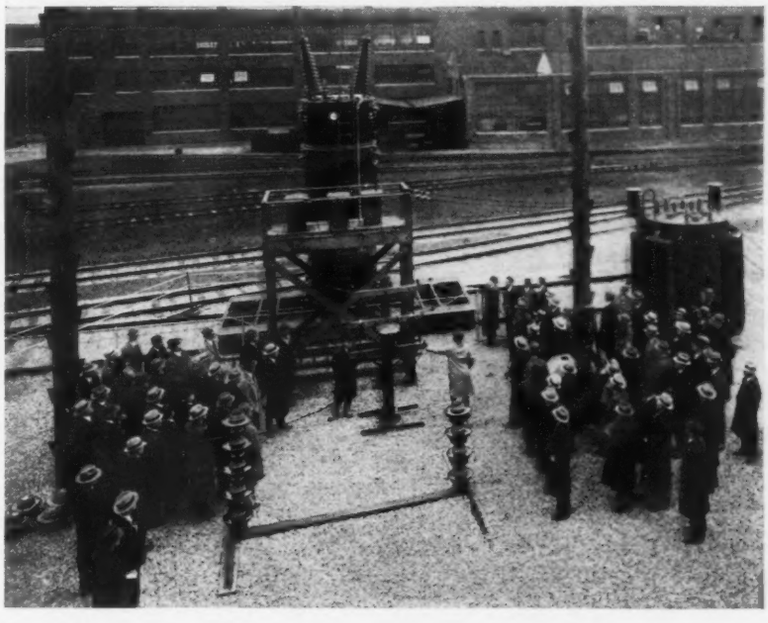
Arrangements have recently been completed by which "1932" Kolster International radio receiving sets will be sold in continental United States by the Westinghouse Electric Supply Company and a group of electric wholesalers doing business with that company, located in approximately 100 strategic jobbing centers.

•

Century Electric Company and subsidiaries report for the year ended December 31, 1931, consolidated net loss, after charges and depreciation and allowing for $27,825 profit from capital stock transactions, amounting to $49,099, against a net loss of $88,199 in the preceding year.

▼ ▼ ▼

LIGHTNING TESTS LEAVE TRANSFORMERS UNHARMED



Lightning flashes of 1,500,000 volts proved harmless to the Deïon-equipped distribution transformer developed by the Westinghouse Electric & Manufacturing Company in a demonstration test witnessed by executives, operating managers and engineers representing electrical power companies of Pennsylvania and Ohio.

New Equipment Available

Photoflood Lamp Supplements Photoflash

A new photographic light source, the "Mazda" photoflood lamp, designed especially for amateur motion picture photography and time exposures, has been announced by the General Electric Company, Nela Park, Cleveland, Ohio. The new lamp, which burns on regular lighting circuits of 105 to 125 volts, resembles the standard 60-watt inside-frosted "Mazda" lamp in bulb size and appearance. Its extremely high operating efficiency causes its photographic effectiveness to be approximately that of a 750-watt general service lamp and results in comparatively short lamp life—120 minutes at 115 volts. Five lamps fully load one circuit.

▼

Magnetic Operation Improves Sand Molder

Development and commercialization of self-contained foundry sand molding machines operating on a principle said to be new to that field has been announced in England. These machines are solenoid operated, thereby eliminating the motor embodied in all previous electrical equipment made for this purpose and at the same time obviating the necessity for air or hydraulic pipe lines, with their accompanying compressors and accumulators. The magnetically operated machine is also said to reduce energy costs to a major degree. Such a machine is capable of squeezing a box of maximum 27x18 in. dimensions at the rate of 30 molds per hour. With electricity at 2 cents a kilowatt-hour the cost for eight hours' operation is about 3 cents.

▼

A SUNDAY AND HOLIDAY CUTOUT, as well as an advanced time cutoff, is now available for any type TM or TC time switch, it is announced by the Sangamo Electric Company, Springfield, Ill. The mechanism of both new features is of simple and rugged design. A wide variety of omitting operations is thus permitted. Various combinations can be changed promptly and accurately with a minimum of effort.

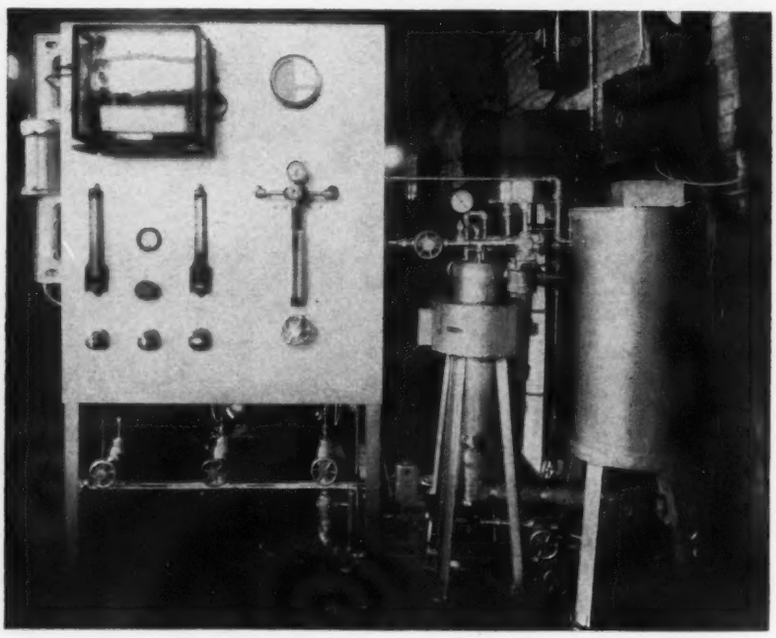
•

A NEW S-11 "MAZDA" B LAMP in the 6-watt size for sign service has been announced by the incandescent lamp department of the General Electric Company, Nela Park, Cleveland, Ohio. This source is said to be particularly effective in the light colors for small signs over the sidewalk where the essential requirements are low mounting, close viewing, high competitive brightness and individuality in color and design.

▼

Liquid Anhydrous Ammonia Dissociated at Low Cost

Equipment for dissociating liquid anhydrous ammonia available in three standard sizes, the capacities of which are 50, 250 and 600 cu.ft. per hour, and simple to operate, being practically automatic, is announced by the Westinghouse Electric & Manufacturing Company, Mansfield, Ohio. The use of this gas has been retarded by the lack of proper equipment for dissociating these gases in a pure state free from excessive quantities of raw ammonia and moisture.



The dissociator is so designed that when it is operated at rated capacity the dissociation is about 99.5 per cent. Each pound of liquid ammonia yields 45 cu.ft. of dissociated gas. Based on the cost of operating the dissociator, with power rate of $0.01 per kilowatt-hour, the cost of dissociated gas is approximately $3.75 per thousand cubic-feet. If the liquid ammonia is purchased in tank car lots at a cost of $0.06 per pound, the cost of dissociated gas would then be approximately $1.60 per thousand cubic-feet.

Electronic Relay of High Sensitivity

Positive control of a current of 6 amp. at 220 volts with a minute flow of 0.000001 amp. is the achievement realized in the Burgess micro-relay. This relay transforms normally indistinguishable contacts into readily distinguishable, powerful, useful forces. In this characteristic lies its greatest value for temperature control work, go and no-go and maximum and minimum control settings on sensitive indicating meters and other apparatus. The device is particularly recommended wherever it is desired to provide indication or control at some predetermined value as shown by any indicating instrument, such as voltmeter, ammeter, pressure gage, thermometer, etc., or in industrial equipment wherein positive action must be obtained by the closing of an electrical circuit through a pair of contacts under slightest pressure. The minimum current required eliminates the hazard of variation or uncertainty of contact due to sparking, arcing, oxidation or contaminating of contacts.

The relay is available in several models for different applications, such as normally open or normally closed, 110-volt or 220-volt, a.c. or d.c. and normal operation or time-delayed operation.

▼

A NEW 6-WATT WESTINGHOUSE LAMP for sign and decorative service is available for service in the 115-volt range and is designed for a life of 2,000 hours. It can be had in the sign lamp colors of red, blue, green, yellow, amber orange, flame tint and white.